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ECO401 Subjective Material

Question No: 55 (Marks: 3)
According to Keynesian school of thought, what should be the role of government in order to bring the economy out of depression?
Answer No: 55
Keynes introduced demand-pull theory which emphasizes strongly the intervention
of government into economy.
According to him economy may be boosted up by increasing expenditure. In the
initial stage government can inject money in the form of investment and higher wage
rate to the government employees. This will create higher demand which in return
result in more investment by firms.
Question No: 56 (Marks: 5)
In the above figure, suppose the economy is on the horizontal portion of aggregate supply (AS) curve.
a) If government expenditures increase, what will happen to the
27
aggregate expenditure line E, aggregate demand curve AD and output level Y.
Answer No: 56 (a)
It will cause more short run demand in the economy and “e” will move to the right
in P-Y space.
It will increase the consumption part of injection as well and “e” will move upward
and right in W.J-Y space.
AD will curve will move to right in P-Y space resulting increasing short run output
“Y”.
b) Is there any multiplier effect? How it works in this case?
Answer No:56 (b)

Yes, multiplier effect exists there.
Keynes multiplier 1/mps is the variable which determines the injection level to
create an hypothetical desired output.
(Marks: 3+2)
Question No: 57 (Marks: 5)
World Bank suggests some structural reform policies for the poor countries to grow. Discuss those policies briefly.
Answer No: 57
These are also called IMF's Stabilization Policies. These were concluded from
neoclassical economics, known since 1990.
The objective of IMF was to ensure both through internal balance (supply=demand,
i.e. low inflation, full employment) and
external balance (sustainable BOP and external debt position).
The approach was "stabilization" through "demand" management.
There are three tools of this policy as follows!
• Tight Monetary Policy
• Tight Fiscal Policy
• Devaluation
IMF Policies effected LIC's badly. There was a very high criticism on above said
policies. The main points of criticism were as follows!
28
• Short-term policy conflicts
• Devaluation could raise prices of imports.
• Demand-reduction policies are anti-growth: increased taxation can stifle the
productive sector.
• Stabilization hurts the poor expenditure cuts almost always fall partly on the
social sectors.
Question No: 58 (Marks: 10)
Recall the Equation of Quantity theory of money and calculate the missing figure in each of the following cases:
a) Money supply (M) =100, Price (P) = 3 and real output (Q) = 200.
Calculate the missing figure.

Answer No: 58 (a)
MV = PQ
100xV = 3 x 200
V = 600 / 100
V = 6
b) Velocity of money (V) = 4, Price (P) = 5 and output (Q) =100. Calculate the missing figure.
Answer No: 58 (b)
MV = PQ
M x 4 = 5 x 100
M = 500 / 4
M = 125
c) Money supply (M) = 200, velocity of money (V) = 7 and output (Q) = 700. Calculate the missing figure.
Answer No: 58 (c)
MV = PQ
200 x 7 = P x 700
P = 1400 / 700
P = 2
d) Money supply (M) =150, velocity of money (V) = 8, Price level (P) = 29
3. Calculate the missing value.
Answer No: 58 (d)
MV = PQ
150 x 8 = 3 x Q
Q = 1200 / 3
Q = 400
(Marks: 2.5 each)

Question No: 51 (Marks: 5)
Briefly discuss the private cost of advertising. How we can calculate the marginal social cost?
ANSWER: Private Cost Of Advertising: The private cost of advertising is the
cost incurred by firm in making the advertisement i.e newspaper adds, tv commercials etc. The firms do not take into account the nuisance faced by 41
people due to these advertisements otherwise the firms would do less

advertisement.
Marginal Social Cost: Marginal social cost is not a monetary based cost. It is the cost borne by the society as a whole. It is the cost of consumption of one next unit.
Question No: 52 (Marks: 10)
A. What conclusions are derived from exogenous growth theory?
ANSWER: Exogenous Growth Theory: The major conclusions derived from the exogenous growth are as follows:
I The steady growth rate of real GDP depends on exogenous rates of growth of population (n) and technology (t). There are no policies for government for how to affect the steady growth rate of a country. Higher savings can only have a little effect on income it cannot cause long term growth because savings cause diminishing returns to investment and capital accumulation.
I If one country started with lower income and capital than another country, the poorer country will grow faster to catch up the richer country and then both the countries will grow together.
B. What is meant by convergence theory? Explain the convergence theory in the given graph.
(Marks: 4+6)
Question No: 53 (Marks: 10)
Define fiscal policy. Differentiate between contractionary and expansionary fiscal policy. In which situations, budget deficit and budget surplus exist?
Answer: Fiscal Policy: Fiscal policy is the government's about the
• expenditure in form of purchases, subsidies and interest payments on debt etc.
• revenue in form of taxes etc.
Difference between Contractionary and Expansionary Fiscal Policy:
Contactionary Fiscal Policy Expansionary Fiscal Policy

In conactionary fiscal policy
government decreases its expenditure.
In expansionary fiscal policy
government increases its expenditure.
Budget Deficit and Budget Surplus: Budget deficit exists if government expenditure increases the revenue earned. In this case government needs to finance its expenditure through borrowing.

Budget surplus exists when revenue exceeds the government expenditure. In this condition government can easily pay off its debt borrowings.
(Marks: 2+4+4)

Question No: 54 (Marks: 10)

Discuss the basic theories regarding IMF's stabilization program. Are these theories successful? If not, give reasons.

Answer: IMF's Stabilization Theories:

I Tight Fiscal Policy: It works through higher revenues and reduced government expenditure.

I Devaluation: Switching from imports to home produced goods. It increases competitiveness, exports and increase investors confidence in local currency.

I Tight Monetary Policy: Higher interest rates resulting in reduced private sector consumption and investment demand. It reduces inflation and increases savings. High interest rates also results in higher capital inflow.

Theses theories are generally not successful in lower income countries (LICs).

Because they caused the problems of:

• Devaluation: It raises the price of imports and also increased the inflation while the real wage rate could not increase.

• Stabilization hurts poor: decrease in expenditure always badly effects the poor which can then cause political instability

Question No: 53 (Marks: 10)

Define M0 and M1. Briefly discuss the three broad motives of holding money.
(Marks:4+6)

Question No: 54 (Marks: 10)

Recall the Equation of Quantity theory of money and calculate the missing figure in each of the following cases:

a) Money supply (M) =100, Price (P) = 3 and real output (Q) = 200. Calculate the missing figure.

b) Velocity of money (V) = 4, Price (P) = 5 and output (Q) =100. Calculate the missing figure.

c) Money supply (M) = 200, velocity of money (V) = 7 and output (Q) = 700. Calculate the missing figure.

d) Money supply (M) =150, velocity of money (V) = 8, Price level (P) = 3. Calculate the missing value.(Marks: 2.5 each)

Question No: 49 (Marks: 3)

Mention the transactions that cause the demand for dollars to increase in the foreign exchange market.

Pakistani imports of US goods.
Pakistani travelers traveling to the US.
Pakistani students paying for study in US universities.
profits repatriated to US by US firms operating in Pakistan.

Question No: 50 (Marks: 3)

Why countries have comparative advantage according to Ricardo?

Comparative advantage according to Ricardo:

The law of **comparative advantage** refers to the ability of a party (an individual, a firm, or a country) to produce a particular good or service at a lower opportunity cost than another party. There is a source of comparative advantage can be productivity differentials.Ricardo argued that there is mutual benefit from trade (or exchange) even if one party **(e.g. resource rich country, highly-skilled artisan**) is more productive in every possible area than its trading counterpart

(e.g. resource-poor country, unskilled laborer), as long as each concentrates on the activities where it has a relative productivity advantage

Question No: 51 (Marks: 5)

A.

"Slope of the consumption function is less than 1".What is meant by this statement?

When we drawn in expenditure income space, the consumption function plots as a straight line with positive intercept, and a positive but less than 1 slope.

The slope is less than 1 because not all the income is consumed some part of the
income is saved.

**B. What are the major macroeconomic variables involved in the determination
of national income?
(Marks: 2+3)**

C, I, G, X, M, T, S, prices, exchange rate, interest rate and money supply.

Question No: 52 (Marks: 5)

**What are the conditions in which foreign exchange market exists? Also give
some examples of foreign exchange markets.**

In a market there are buyers and sellers who negotiate and agree on the price for
the or
price for the commodity being exchanged. The foreign exchange market is no
different.
whatever, here the commodity being traded is foreign exchange and the price is
the foreign exchange rate. Specifically, a foreign currency is being traded for the
Pakistani Ruppee at a particular rate of exchange.
The sellers and buyers of foreign exchange are not mutually exclusive. The sellers of today, may be the buyers of tomorrow, or even of today.
Foreign exchange market exists when **buyers and sellers** exit and ready to sell
and buy.
The **main driving force** for foreign exchange market is the law of supply and
demand.

Examples are US $-PAK RS Foregin exchange market
US $ - UK POUND Foregin exchange market

Question No: 53 (Marks: 5)

**What thing determines comparative advantage among countries according to
Hechshcer-Ohlin? What is the criticism against their argument?**

According to Hechshcer-Ohlin suppose we are given two countries one abundant
in labour and one abundant in capital and a labour-intensive good and a capital
intensive
good, the labour abundant country will have comparative advantage in the production of the labour-intensive good while the capital abundant country will
have comparative advantage in the capital-intensive good.
So the determinants of comparative advantage among countries according to Hechshcer-Ohlin is capital goods and labour intensive goods.
Critics argued that comparative advantage can and should be viewed in a dynamic (time-varying) sense, and that it was not wise to rule out the possibility
of Pakistan developing comparative advantage in cars at some future point in time.
Consequent:
The major criticism leveled against Hechscher-Ohlin type trade theories are that
they views
comparative advantage in an essentially static sense; i.e. if Pakistan is better at
producing
cotton and Japan better at producing, then this situation will always prevail.

Question No: 49 (Marks: 3)
Define balance of payment (BOP). How the BOP can be determined?
Answer:
A BOP is a sheet in other words an account sheet which is an accounting record of
all monetary transactions between a country and the rest of the world.
These transactions include
Payments for the country's exports and imports of goods, services,
and financial capital, as well as financial transfers.
The BOP summarizes international transactions for a specific period, usually a year,
and is prepared in a single currency, typically the domestic currency for the country concerned.

Surplus items:
Sources of funds for a nation, such as exports or the receipts of loans and investments, are recorded as positive/surplus items.
Deficit items:
Uses of funds, such as for imports or to invest in foreign countries, are recorded as a
negative or deficit item.
It can be determined if we see the things in both prespective.In other words it is a
non-complicated way, lets assume that we have two countries Pakistan and united
states and things are viewed from Pakistan point of view.
For this purpose we must now the market for foreign exchange. Foreign exchange
in a Pakistani context means US $ and in a US point of view it is Pak rupees.

Question No: 50 (Marks: 3)
Explain the shape of money demand curve with the help of diagram.
Answer:
Money demand Md increases with income levels.
Money demand Md falls with interest rates.
In this concept we are talking about real income and real interest rate not the nominal income and nominal interest rate.
So this implies to the demand of real money.
Whether nominal and real money supply is equal or not depends much on the
assumption regarding prices. If prices are assumed fixed, then the two are equal,
otherwise not.
As you can see from the diagram where money demand in on the x-axis and income is on the y-axis, and there are various level showns like L1,L2,L3.
i
Money demand
curve
Y
L2
- Y
L1

L3
L
o
Money Demand

Question No: 51 (Marks: 5)
How can a current account, which is in deficit, be restored to balance under
fixed exchange rate regimes?
Answer:
There is solution for how can a current account which is in deficit be restored to
balance under fixed exchange rate regimes. The answer is **"Economic Deflation"**
Economic Deflation says When a country's national income rises, it spends more;
part of that spending falls on imported goods; higher imports cause the current
account to worsen.
The reverse is also true for this lower income must reduce import spending and
therefore improve the current account spending.
However, economic contraction is not a good idea to restore current account equilibrium the other alternative solution presented by economist is to devaluate or
"devaluation".
Devaluation is the phenomena related to exchange rate where exchange rate faces
depreciation but in the context of fixed exchange rates. The complement of devaluation is revaluation.
A concept of devaluation is to bring the exchange rate in line with its long-run
equilibrium level, i.e. a level consistent with international competitiveness.
Competitiveness is simply defined as the real exchange rate RER, where RER =
(Pf/Pd)*NER. Where
NER
Pf

Pd
Nominal Exchange rate
is the price level prevailing in the foreign country (US)
is the price level prevailing in the home country (Pakistan).
The formula implies that, for a fixed NET if inflation is higher in Pakistan (relative
to
the US), Pakistani exports will become less attractive in the international market. As

a result, our exports will fall, and current account will go into deficit.
To fix this problem, the NER can be devalued so as to make our goods cheaper and
competitive and it is to bring competitiveness back to its original higher level.
However, there are many provisos attached to the devaluation policy prescription.
Devaluation only works if the country's exports and imports are elastic, otherwise
the price effect of the devaluation will dominate the volume effect and the current
account will worsen. Secondly, the country must have excess productive capacity
in order to meet the higher demand for exports that is created as a result of the
devaluation. Thirdly, the country should not have a very high foreign debt whose
burden increases so much as a result of the devaluation that the negative effects
associated therewith overwhelm any positive competitiveness effects.
Capital account (+ or -)
+
-
+
-
Incoming FDI, FPI or other private capital
Outgoing FDI, FPI or other private capital
Borrowing, aid inflows

Payments of debt principal, aid outflows

Question No: 52 (Marks: 5)

Identify which of the following are stock variables and which are flow variables?

a) Unemployment Stock

b) Redundancies (job lay-offs) Flow

c) Profits Flow

d) A firm's stock market valuation (share price) Stock

e) The value of property after a period of inflation Stock

(Marks: 1 for each)

Question No: 53 (Marks: 5)

World Bank suggests some structural reform policies for the poor countries to grow. Discuss those policies briefly.

Ans:

World Bank has suggested following policies for the poor countries to grow,

1.

Governance and administrative reforms: To reduce over employment in public sector, reduce wastes and to improve the quality and reliability of public services. To strengthen the administration of taxes, to eliminate the corruption. To

decentralize the control of fiscal policy making. To enrich the legal and regulator framework.

2.

Privatization of state-owned enterprises: Abbreviated as SOEs. These are influenced by political interference and it is one of the reasons SOEs are considered inefficient. SOEs are also suffering form lack of competition, cost awareness and fear of bankruptcy.

3.

Financial liberalization: It involves ending of financial repression policies including artificially low interest rates, credit rationing, restrictions on banking

competition and government involvement in investment allocation
4.
5.
6.
Liberalization of prices, removal of subsidies
Deregulation involving dismantling of licensing systems and red-tape
Trade liberalization: including tariffication of non-tariff-barriers, harmonization of tariffs and an eventual reduction thereof
7.
FDI liberalization: To create a transparent, predictable environment for foreign investors to operate in.
8.
Capital account liberalization: To remove controls on capital flows
These policies are suggested by world bank and the successful implementation of
these policies depend on the political and economic system of poor countries. In
general these policies are expected to provide the poor nation with better understanding and help them to raise their growth.

ECO401 CURRENT PAPERS SUBJECTIVE

Question No: 49 (Marks: 3)

What is meant by exchange rate? Also give example of exchange rate.

Answer:

EXCHANGE RATE:

Rate at which one currency may be converted into another. The exchange rate is used when simply converting one currency to another (such as for the purposes of travel to another country), or for engaging in speculation or trading in the foreign exchange market. There are a wide variety of factors which influence the exchange rate, such as interest rates, inflation, and the state of politics and the economy in each country.**also called** rate of exchange or foreign exchange rate or currency exchange rate.

EXAMPLE:
An exchange rate of 123 Japanese yen (JPY, ¥) to the United States dollar

(USD, $) means that JPY 123 is worth the same as USD 1.

Question No: 50 (Marks: 3)

What is the reason of poverty in developing countries according to Prebisch-Singer hypothesis?

ANSWER:

POVERTY means the state of being poor; lack of the means of providing material needs or comforts.

According to Prebisch-Singer hypothesis following are the reason of poverty in developing countries:

- One of the reson for poverty is increasing population.
- Another reason **Lack of precious natural resources (like oil, gold, gas, iron, copper etc.)** was also cited by some as the reason for LICs' continued poverty.

Question No: 51 (Marks: 5)

According to the values given in the following table, calculate the injections at each level of output.

Output (Y)	Saving (S)	Gross Imports (M)	Gross investment (I)	Gross exports (X)	Govt. Expenditures (G)	Taxes (T)
650	80	80	104	97	116	10
700	90	80	119	97	116	10
750	100	80	130	97	116	10
800	110	80	139	97	116	10
900	120	80	146	97	116	10

(Marks: 1 for each)

ANSWER:

We know:

INJECTION=I+X+G

SO,

the injections at each level of output=

1-317

2-332

3-343

4-352

5-359

Question No: 52 (Marks: 5)

What are the major weaknesses of exogenous growth theory? Which theory was developed in against of exogenous growth theory?

ANSWER:

EXOGENOUS GROWTH THEORY:

The Exogenous growth model, also known as the Neo-classical growth model or Solow growth model is
a term used to sum up the contributions of various authors to a model of long-run economic growth
within the framework of neoclassical economics.

Exogenous growth theory suffered from three major weaknesses:

i. It could not explain why the gap between the poor and rich countries had widened (anticatch
up),

ii. It could not explain why some countries in East Asia had apparently grown consistently
on the back of higher saving rates, and

iii. It modeled technology as exogenous, and beyond the influence of policy.

PART B SOLUTION:

In economics, **endogenous growth theory** or **new growth theory** was developed in the 1980s as a
response to criticism of the neo-classical growth model OR exogenous growth theory

Question No: 53 (Marks: 5)

Discuss the components on the assets and liabilities side of the balance sheet of a central bank.

ANSWER:

Following are the components on the assets and liabilities side of the balance sheet of a central bank

ASSET SIDE COMPONENTS:

- Loans to Govt Notes
- Forex reserves
- Loans to private sector

LIABILITY SIDE COMPONENTS:

- Notes, coins & currency in circulation
- Govt & commercial bank deposits
- Liquidity paper issued

Question No: 49 (Marks: 3)

Define balance of payment (BOP). How the BOP can be determined?

ANSWER:

THE BALANCE OF PAYMENTS (BOP):

BOP is an accounting record of a country's transactions with the rest of the world.

The balance of payments (or BOP) measures the payments that flow between any individual country and all other countries. It is used to summarize all international economic transactions for that country during a specific time period, usually a year.

PART B SOLUTION:

How the BOP can be determined?

IT CAN BE DETERMINED IN THE FOLLOWING WAY:

The BOP is determined by the country's exports and imports of goods, services, and financial capital, as well as financial transfers. It reflects all payments and liabilities to foreigners (debits) and all payments and obligations received from foreigners (credits).

Balance of payments is one of the major indicators of a country's status in international trade, with net capital outflow.

Question No: 50 (Marks: 3)

Explain the shape of money demand curve with the help of diagram.

Answer:

PERFECT ANSWER ON THIS LINK IS AVAILABLE SEE THIS(PG 9 AND PG 10)
http://www.ssc.wisc.edu/~ldrozd/my_files/102files/slides_9.pdf

Question No: 51 (Marks: 5)

How can a current account, which is in deficit, be restored to balance under fixed exchange rate regimes?

Answer:

There is solution for how can a current account which is in deficit be restored to balance under fixed exchange rate regimes. The answer is **"Economic Deflation"**
Economic Deflation says When a country's national income rises, it spends more; part of that spending falls on imported goods; higher imports cause the current account to worsen.
The reverse is also true for this lower income must reduce import spending and therefore improve the current account spending.
However, economic contraction is not a good idea to restore current account equilibrium the other alternative solution presented by economist is to devaluate or "devaluation".
Devaluation is the phenomena related to exchange rate where exchange rate faces depreciation but in the context of fixed exchange rates. The complement of devaluation is revaluation.
A concept of devaluation is to bring the exchange rate in line with its long-run equilibrium level, i.e. a level consistent with international competitiveness.

Question No: 52 (Marks: 5)

Identify which of the following are stock variables and which are flow variables?
hese are the terms used to differentiate things like "wealth versus income" or

"debt versus deficit."

That is, a "stock variable" is a variable measurable at one particular time (wealth); whereas, a "flow variable" is a variable measured after a prolonged amount of time retrospecting spending in the past "x" amount of time (income).

a) **Unemployment**
b) **Redundancies (job lay-offs)**
c) **Profits**
d) **A firm's stock market valuation (share price)**
e) **The value of property after a period of inflation**

(Marks: 1 for each)

ANSWER:

DEFINITION IS JST FOR CONCEPT NOT THE ANSWER.

These are the terms used to differentiate things like "wealth versus income" or "debt versus deficit."

That is, a "stock variable" is a variable measurable at one particular time (wealth); whereas, a "flow variable" is a variable measured after a prolonged amount of time retrospecting spending in the past "x" amount of time (income).

REQUIRED ANSWER:

FOLLOWING ARE THE STOCK VARIABLES:

- Unemployment
- A firm's stock market valuation (share price)
- The value of property after a period of inflation
-

FOLLOWING ARE THE FLOW VARIABLES:

- Redundancies (job lay-offs)
- Profits

Question No: 53 (Marks: 5)

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Ans:

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To reduce over employment in public sector, reduce wastes and to improve the quality and reliability of public services. To strengthen the administration of taxes, to eliminate the corruption. To decentralize the control of fiscal policy making. To enrich the legal and regulator framework.

Privatization of state-owned enterprises:
Abbreviated as SOEs. These are influenced by political interference and it is one of the reasons SOEs are considered inefficient. SOEs are also suffering form lack of competition, cost awareness and fear of bankruptcy.

Financial liberalization:
It involves ending of financial repression policies including artificially low interest rates, credit rationing, restrictions on banking competition and government involvement in investment allocation

Deregulation involving dismantling of licensing systems and red-tape

Trade liberalization:
including tariffication of non-tariff-barriers, harmonization of tariffs and an eventual reduction thereof

FDI liberalization:
To create a transparent, predictable environment for foreign investors to operate in.

apital account liberalization:
To remove controls on capital flows

(These policies are suggested by world bank and the successful implementation of these policies depend on the political and economic system of poor countries. In general these policies are expected to provide the poor nation with better understanding and help them to raise their growth.)

Question No: 50 (Marks: 3)

Differentiate between international trade and international finance.

ANSWER:
By **international trade**, we mean the exchange of goods and services between different countries.

International trade is the trade between two or more different countries. It is just the opposite of the trade that takes place within a country i.e. national trade.

Whereas **International finance** is concerned with, among other thing, the mobility of financial capital across countries, and the problems and opportunities this mobility presents individual countries with. It would not be too inaccurate (in present day context) to say that while international trade deals with the current account, international finance deals with the capital account of the BOPs. That said, issues like the choice of exchange rate regime and of modern-day balance of payments crises also fall firmly within the purview of international finance.

Question No: 51 (Marks: 5)

Discuss the components on the assets and liabilities side of the balance sheet of a central bank.

ANSWER:

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LIABILITY SIDE COMPONENTS:

- Notes, coins & currency in circulation
- Govt & commercial bank deposits

Liquidity paper issued

Question No: 53 (Marks: 5)

If y = Y / L, where, Y = Total GDP, L = Population, y = Per capita GDP then prove that Growth rate of per capita income = Growth rate of total output - Growth rate of population

ANSWER:
$y = Y / L$
Where,
• Y = Total GDP
• L = Population
• y = Per capita GDP
Taking log of both sides
• $\ln y = \ln Y - \ln L$
Taking derivative *w.r.t.* time
• $1/y \, (dy/dt) = (dY/dt)/Y - (dL/dt)/L$
$gy = gY - gL$

Growth rate of per capita income = Growth rate of total output - Growth rate of population
REFRENCE:
CHP NO 38 PAGE NO 168

Question No: 49 (Marks: 3)

Differentiate between inflation and deflation.

ANSWER:

Inflation is a situation in which there is a continuous rise in the general price level.
WHEREAS **Deflation** is the
opposite of inflation and occurs when the general level of prices falls.

Inflation is when the money supply increases by more than the real economy does. This means that one unit of currency will buy less than it could in the past.
Deflation is when the money supply contracts, making a unit of currency able to buy more than it could in the past. This is the exact opposite of inflation, but it is also bad.

Question No: 50 (Marks: 3)

What are the reasons that poor countries remained poor?

Question No: 51 (Marks: 5)

Explain the difference between endogenous growth model and exogenous growth model.

Question No: 52 (Marks: 5)

EXOGENOUS GROWTH THEORY

The Exogenous growth model, also known as the Neo-classical growth model or Solow growth model is
a term used to sum up the contributions of various authors to a model of long-run economic growth
within the framework of neoclassical economics

ENDOGENOUS GROWTH THEORY

In economics, **endogenous growth theory** or **new growth theory** was developed in the 1980s as a
response to criticism of the neo-classical growth model.
In neoclassical growth models, the long-run rate of growth is exogenously determined by assuming a
savings rate (the Solow model) or a rate of technical progress. This does not explain the origin of
growth, which makes the neo-classical model appear very unrealistic. Endogenous growth theorists see
this as an over-simplification

Following table shows different stages of production of cloth. Calculate the value added at each stage of production. What is GDP by this approach?

Stage of production	Money value (Rs)	Value added at each stage (Rs)
Raw cotton	10.50	**?**
Cotton yarn	25.68	**?**
Coarse cloth	45.82	**?**
Finished cloth	55.66	**?**

ANSWER:

Stage of production	Money value (Rs)	Value added at each stage (Rs)
Raw cotton	10.50	10.50
Cotton yarn	25.68	15.18

Coarse cloth	45.82	20.14
Finished cloth	55.66	9.84

REFERENCE

METHODS OF MEASURING GDP

There are three equivalent ways of measuring GDP:

i. The product or value added method which sums the value added by all the productive entities in the economy;

ii. The expenditure method which sums up the value of all the "final goods" transactions taking place in the economy;

iii. The factor income method which sums up all the incomes earned by all the factors of production in the economy (rent for land, wages for labour, interest for capital, and equity returns for entrepreneurship).

Value added is the difference between the value of goods produced and the cost of materials and supplies used in producing them. Value added consists of the wages, interest and profit components added to the output by a firm. Value added is the difference between inputs and outputs e-g if a firm spends Rs.500 making a good (inputs) and sells its product (output) for Rs.750, then value added is Rs.250.

Question No: 53 (Marks: 5)

Discuss the equilibrium condition in money market. Explain this equilibrium condition with the help of diagram.

ANSWER= CHP NO 43

Question No: 49 (Marks: 3)

It is said that growth is an important macroeconomic issue. Why?

Discuss.

ANSWER:

Why Growth is an Important Macroeconomic Issue:

It is obvious why growth is an important macroeconomic issue. Every government aspires to deliver a higher growth rate for the country. High growth rates means higher national income which means better living standards on average, which in democracies, means happier electorates and therefore increased chances of re-election for another term in office. However, while all countries might wish to achieve high growth rates, in practice, only a handful have been able to convert the wish into reality.

Question No: 50 (Marks: 3)

What are the different borrowing options available to the government for reducing the fiscal deficit?

By borrowing locally (i.e. issuing bonds), foreign financing (including non-relpayable grants) or printing money (i.e. borrowing from the central bank). The first of these methods is least inflationary while the last one is most inflationary.

Question No: 52 (Marks: 5)

Differentiate between fixed exchange rate and floating exchange rate.

ANSWER:

Fixed exchange rate:

.A fixed exchange rate means the amount of currency received is set in advance.

A fixed exchange rate is based upon the government's view of the value of its currency as well as the monetary policy. It has advantages. Stability is one. Another is predictability. Businesses and individuals can plan their activities with the certainty of the value of money. A businessman shipping goods overseas knows the value in advance. A tourist travelling in other countries can budget knowing what his money will buy.

Floating exchange rates:

A floating exchange rate means that the rate is moving and the currency received depends on the time of the exchange

.The floating exchange rate, in its true form, allows the marketplace to set the rate. The forces of supply and demand determine the value of a currency.

For example, when the US dollar is considered strong it will take more euros, the currency of most European countries, to buy. When the US dollar is considered weak or in decline the amount of euros needed to buy it will fall.

Question No: 53 (Marks: 5)

Some economists suggest "growth through trade strategy" to tackle the problem of poverty of under developed countries.

a) **What is the basic theme of this strategy?**
b) **Why this strategy is not so much successful?**
c) **What is the proposed solution presented to tackle the drawback of this strategy?**

Question No: 49 (Marks: 3)

Mention the transactions that cause the demand for dollars to increase in the foreign exchange market.

Pakistani imports of US goods.
Pakistani travelers traveling to the US.
Pakistani students paying for study in US universities.
profits repatriated to
US by US firms operating in Pakistan.

Question No: 50 (Marks: 3)

Why countries have comparative advantage according to Ricardo?

ANSWER:

Comparative advantage according to Ricardo:

The law of **comparative advantage** refers to the ability of a party (an individual, a firm, or a country) to produce a particular good or service at a lower opportunity cost than another party. There is a source of comparative advantage can be productivity differentials.Ricardo argued that there is mutual benefit from trade (or exchange) even if one party (**e.g. resource rich country, highly-skilled artisan**) is more productive in every possible area than its trading counterpart (e.g. resource-poor country, unskilled laborer), as long as each concentrates on the activities where it has a relative productivity advantage

Question No: 51 (Marks: 5)
A.

"Slope of the consumption function is less than 1".What is meant by this statement?

ANSWER:
When we drawn in expenditure income space, the consumption function plots as a straight line with positive intercept, and a positive but less than 1 slope. The slope is less than 1 because not all the income is consumed some part of the income is saved.

B. What are the major macroeconomic variables involved in the determination of national income?

(Marks: 2+3)

Following are the major macroeconomic variables involved in the determination of national income :

C, I, G, X, M, T, S, prices, exchange rate, interest rate and money supply.

Question No: 52 (Marks: 5)

What are the conditions in which foreign exchange market exists? Also give some examples of foreign exchange markets.

In a market there are buyers and sellers who negotiate and agree on the price for the or
price for the commodity being exchanged. The foreign exchange market is no different.
whatever, here the commodity being traded is foreign exchange and the price is the foreign exchange rate. Specifically, a foreign currency is being traded for the Pakistani Ruppee at a particular rate of exchange.
The sellers and buyers of foreign exchange are not mutually exclusive. The sellers of today, may be the buyers of tomorrow, or even of today.
CONDITION:

Foreign exchange market exists when **buyers and sellers** exit and ready to sell and buy.
The **main driving force** for foreign exchange market is the law of supply and demand.

EXAMPLE:

US $-PAK RS Foregin exchange market
US $ - UK POUND Foregin exchange market

Question No: 53 (Marks: 5)

What thing determines comparative advantage among countries according to Hechshcer-Ohlin? What is the criticism against their argument?

According to Hechshcer-Ohlin suppose we are given two countries one abundant
in labour and one abundant in capital and a labour-intensive good and a capital intensive
good, the labour abundant country will have comparative advantage in the production of the labour-intensive good while the capital abundant country will have comparative advantage in the capital-intensive good.
So the determinants of comparative advantage among countries according to Hechshcer-Ohlin is capital goods and labour intensive goods.

Critics argued that comparative advantage can and should be viewed in a dynamic (time-varying) sense, and that it was not wise to rule out the possibility of Pakistan developing comparative advantage in cars at some future point in time.

Consequent:

The major criticism leveled against Hechscher-Ohlin type trade theories are that they views
comparative advantage in an essentially static sense; i.e. if Pakistan is better at producing
cotton and Japan better at producing, then this situation will always prevail.

Question No: 49 (Marks: 3)

Differentiate between inflation and deflation.

ANSWER:

Inflation is a situation in which there is a continuous rise in the general

price level.
WHEREAS **Deflation** is the
opposite of inflation and occurs when the general level of prices falls.

Inflation is when the money supply increases by more than the real economy does. This means that one unit of currency will buy less than it could in the past.
Deflation is when the money supply contracts, making a unit of currency able to buy more than it could in the past. This is the exact opposite of inflation, but it is also bad.

(Marks: 5)

What is meant by Philips Curve? Explain the shape of this curve with the help of diagram.

Philips Curve

W.A.Philips gave the idea of Keynes a formalized shape and draws the Philips curve stating inverse
relationship between unemployment and inflation rate.
Philips's views were consistent with the Keynesian views. The cost of reducing inflation is
unemployment and the cost of reducing unemployment is inflation

DIAGRAM

For diagram take a look on chp#34 page no 149.

(I DON,T HV MICROSOFT WORD IN MY PC THATS Y GRPAH CAN,T BE DRAW HERE)

Question No: 53 (Marks: 5)

How crowding out of investment demand occur due to expansionary fiscal policy?

ANSWER CAN BE:

In economics, **crowding out** is any reduction in private consumption or investment that occurs because of an increase in government spending. If the increase in government spending is financed by a tax increase, the tax increase would tend to reduce private consumption. If instead the increase in government spending is not accompanied by a tax increase, government borrowing to finance the increased government spending would increase

interest rates, leading to a reduction in private investment, although there is no empirical evidence that supports such interest rate effect on investment

1. Comments of current account in balance of payment 3 marks
ANSWER:
THE CURRENT ACCOUNT
The current account balance is essentially the trade balance (exports minus imports), but with net factor
receipts from abroad added.
If the exchange rate is fixed, then changes in reserves must mirror the combined balance on the current
and capital accounts in order to bring the overall BOPs to zero. If the exchange rate is floating, then
changes to reserves can remain zero, as the adjustment burden is borne by the exchange rate which
appreciates (depreciates) in response to a joint surplus (deficit) on the current and capital accounts.
REFRENCE FOR COMPLETE CONCEPT:
PARTS OF BOP
The BOPs can be divided into three parts:
i. Current account,
ii. Capital account and
iii. Changes to reserves

2. **The reason of poverty in developing countries according Perbisch-Singer Hypothesis**
(3 marks)
ANSWER:

POVERTY means the state of being poor; lack of the means of providing material needs or comforts.

According to Prebisch-Singer hypothesis following are the reason of poverty in developing countries:

- One of the reson for poverty is increasing population.
- Another reason **Lack of precious natural resources (like oil, gold, gas, iron, copper etc.)** was also cited by some as the reason for LICs' continued poverty.

3. Pull demand inflation, cost push inflation (5 marks)

ANSWER:

DEMAND PULL INFLATION:

The inflation resulting from an increase in aggregate demand is called **demand-pull inflation**. Such an inflation may arise from any individual factor that increases aggregate demand, but the main ones that generate *ongoing* increases in aggregate demand are :

Increases in the money supply

Increases in government purchases

Increases in the price level in the rest of the world

COST PUSH INFLATION:

Inflation can result from a decrease in aggregate supply. The two main sources of decrease in aggregate supply are

- An increase in wage rates
- An increase in the prices of raw materials

These sources of a decrease in aggregate supply operate by increasing costs, and the resulting inflation is called **cost-push inflation.**

4. **What are the comparative advantages between countries according Hechshcer-Ohlin? And criticisms against it.**

ANSWER:

According to Hechshcer-Ohlin suppose we are given two countries one abundant
in labour and one abundant in capital and a labour-intensive good and a capital intensive
good, the labour abundant country will have comparative advantage in the production of the labour-intensive good while the capital abundant country will have comparative advantage in the capital-intensive good.
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possibility of Pakistan developing comparative advantage in cars at some future point in time.

Consequent:

The major criticism leveled against Hechscher-Ohlin type trade theories are that they views
comparative advantage in an essentially static sense; i.e. if Pakistan is better at producing
cotton and Japan better at producing, then this situation will always prevail

1.components of current account of BOPS:

ANSWER:

Following are the components:

1.GOODS
2.SERVICES
3.INCOME
4.CURRENT ACCOUNT.

(FOR COMPLETE UNDERSTANDING AND MORE COMPONANTS VISIT THIS LINK)

http://www.investopedia.com/articles/03/061803.asp

:

1**. Difference between capital deepening and capital widening(5 MARKS)**

ANSWER:

Capital deepening

is a term used in economics to describe an economy where capital per worker is increasing. It is an increase in the
capital intensity. Capital deepening is often measured by the capital stock per labour hour.Overall, the
economy will expand, and productivity per worker will increase. However, economic expansion will not
continue indefinitely through capital deepening alone. This is partly due to diminishing returns and wear
& tear

capital widening:

is a term used to describe the situation where capital stock is increasing at the

same rate as the labour force, thus capital per worker remains constant. The economy will expand in
terms of aggregate output, but productivity per worker will remain constant

2 .Difference between GNP and NNP:(5 MARKS)
ANSWER:
Gross National Product (GNP):
Gross national product (GNP) is the value, at current market prices, of all final goods and services
produced during a year by the factors owned by the citizens of a country. Thus the income earned by
Pakistani citizens working in the US would be included in Pakistan's GNP but excluded from Pakistan's
GDP. Conversely, the income earned by a US citizen (individual or corporate) in Pakistan would be
included in Pakistan's GDP but excluded from Pakistan's GNP. Generally, GNP = GDP + net factor
income from abroad. The abbreviation for gross national product, which is the total market value of all
goods and services produced by the citizens of an economy during a given period of time, usually one
year. Gross national product often was once the federal government's official measure of how much
output our economy produces.
GNP = GDP + Net factor incomes from abroad
Net National Product (NNP):
Mathematically, national income is net national product (NNP). It is GNP adjusted for depreciation. In
words, it is the net output of commodities and services flowing during the year from the country's
production system in the hands of ultimate consumers. The total market value of all final goods and
services produced by citizens of an economy during a given period of time, usually a year, after
adjusting for the depreciation of capital. Net national product, abbreviated NNP, has the same relation to
net domestic product (NDP) as gross national product (GNP) has to gross

domestic product (GDP). Net
national product also has the same relation to gross national product that net domestic product has to
gross domestic product. Like NDP, NNP is a measure of the net production in the economy.
NNP = GNP – Depreciation allowance

3. Explain Comparative advantage among contries according to Hechshcer-Ohlin. And criricism on it?
ANSWER:
According to Hechshcer-Ohlin suppose we are given two countries one abundant
in labour and one abundant in capital and a labour-intensive good and a capital intensive
good, the labour abundant country will have comparative advantage in the production of the labour-intensive good while the capital abundant country will have comparative advantage in the capital-intensive good.
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Critics argued that comparative advantage can and should be viewed in a dynamic (time-varying) sense, and that it was not wise to rule out the possibility of Pakistan developing comparative advantage in cars at some future point in time.
Consequent:
The major criticism leveled against Hechscher-Ohlin type trade theories are that they views
comparative advantage in an essentially static sense; i.e. if Pakistan is better at producing
cotton and Japan better at producing, then this situation will always prevail.

Q # 1 Difference between inflation and deflation? Marks 3
ANSWER:
Inflation is a situation in which there is a continuous rise in the general price level.
WHEREAS **Deflation** is the
opposite of inflation and occurs when the general level of prices falls.

Inflation is when the money supply increases by more than the real economy does. This means that one unit of currency will buy less than it

could in the past.
Deflation is when the money supply contracts, making a unit of currency able to buy more than it could in the past. This is the exact opposite of inflation, but it is also bad.

Q # 2 How the central banks plays its important role in order to control the activities of commercial banks? Marks 3

central bank, **reserve bank**, or **monetary authority** is a banking institution granted the exclusive privilege to lend a government its currency. Like a normal commercial bank, a central bank charges interest on the loans made to borrowers, primarily the government of whichever country the bank exists for, and to other commercial banks, typically as a 'lender of last resort'. However, a central bank is distinguished from a normal commercial bank because it has a monopoly on creating the currency of that nation, which is loaned to the government in the form of legal tender. It is a bank that can lend money to other banks in times of need. Its primary function is to provide the nation's money supply,

Q # 3 Difference between depreciation and appreciation of currency? Marks 5

ANSWER:

Depreciation:

This is a more or less permanent decrease in value or price. "More or less permanent" doesn't include
temporary, short-term drops in price that are common in many markets. It's only those price declines
that reflect a reduction in consumer satisfaction.While all sorts of stuff can depreciate in value, some of
the more common ones are capital, real estate, corporate stock, and money

APPRECIATION

This is a more or less permanent increase in value or price. "More or less permanent" doesn't include
temporary, short-term jumps in price that are common in many markets. Appreciation is only those
price increases that reflect greater consumer satisfaction and thus value.

While all sorts of stuff can
appreciate in value, some of the more common ones are real estate, works of art, corporate stock, and
money.

Q # 4 what is meant by laffer curve? Also explain the shape of this curve? Marks 5

ANSWER:

The graphical inverted-U relation between tax rates and total tax collections by government is known as
Laffer curve. This curve is developed by economist Arthur Laffer; the Laffer curve formed a key
theoretical foundation for supply-side economics of President Reagan during the 1980s. It is based on
the notion that government collects zero revenue if the tax rate is 0% and if the tax rate is 100%. At a
100% tax rate no one has the incentive to work, produce, and earn income, so there is no income to tax.
As such, the optimum tax rate, in which government revenue is maximized, lies somewhere between 0%
and 100%. This generates a curve shaped like an inverted U, rising from zero to a peak, and then falling
back to zero. If the economy is operating to the right of the peak, then government revenue can be
increased by decreasing the tax rate.

(AGAIN FOR DIAGRAM VISIT PAGE NO 175 OF CHP # 40)

A slope of consumption function is less than 1." What is meant by this statement?

ANSWER:

When we drawn in expenditure income space, the consumption function plots as a straight line with positive intercept, and a positive but less than 1 slope. The slope is less than 1 because not all the income is consumed some part of the income is saved.

Differentiate between Inflation and deflation. Marks3

ANSWER:
Inflation is a situation in which there is a continuous rise in the general price level.
WHEREAS **Deflation** is the
opposite of inflation and occurs when the general level of prices falls.
Inflation is when the money supply increases by more than the real economy does. This means that one unit of currency will buy less than it could in the past.
Deflation is when the money supply contracts, making a unit of currency able to buy more than it could in the past. This is the exact opposite of inflation, but it is also bad

Question No: 49 (Marks: 3)

Define balance of payment (BOP). How the BOP can be determined?

Answer:
A BOP is a sheet in other words an account sheet which is an accounting record of all monetary transactions between a country and the rest of the world.

These transactions include
→ Payments for the country's exports and imports of goods, services, and financial capital, as well as financial transfers.

The BOP summarizes international transactions for a specific period, usually a year, and is prepared in a single currency, typically the domestic currency for the country concerned.

Surplus items:
Sources of funds for a nation, such as exports or the receipts of loans and investments, are recorded as positive/surplus items.

Deficit items:
Uses of funds, such as for imports or to invest in foreign countries, are recorded as a negative or deficit item.

It can be determined if we see the things in both prespective.In other words it is a non-complicated way, lets assume that we have two countries Pakistan and united states and things are viewed from Pakistan point of view.

For this purpose we must now the market for foreign exchange. Foreign exchange in a Pakistani context means US $ and in a US point of view it is Pak rupees.

Question No: 50 (Marks: 3)

Explain the shape of money demand curve with the help of diagram.

Answer:

Money demand Md increases with income levels.

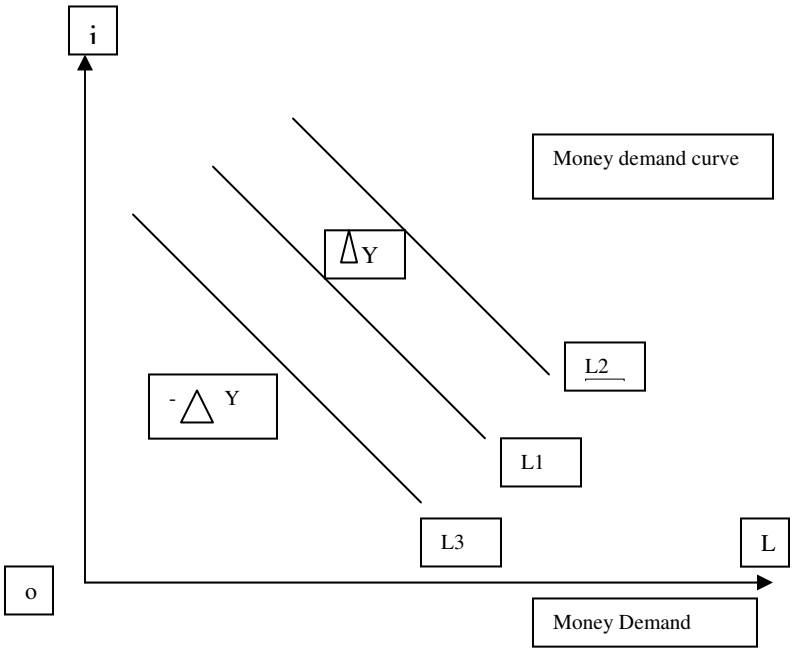
Money demand Md falls with interest rates.

In this concept we are talking about real income and real interest rate not the nominal income and nominal interest rate.

So this implies to the demand of real money.

Whether nominal and real money supply is equal or not depends much on the assumption regarding prices. If prices are assumed fixed, then the two are equal, otherwise not.

As you can see from the diagram where money demand in on the x-axis and income is on the y-axis, and there are various level showns like L1,L2,L3.



Question No: 51 (Marks: 5)

How can a current account, which is in deficit, be restored to balance under fixed exchange rate regimes?

Answer:

There is solution for how can a current account which is in deficit be restored to balance under fixed exchange rate regimes. The answer is **"Economic Deflation"**

Economic Deflation says When a country's national income rises, it spends more; part of that spending falls on imported goods; higher imports cause the current account to worsen.

The reverse is also true for this lower income must reduce import spending and therefore improve the current account spending.

However, economic contraction is not a good idea to restore current account equilibrium the other alternative solution presented by economist is to devaluate or “devaluation”.

Devaluation is the phenomena related to exchange rate where exchange rate faces depreciation but in the context of fixed exchange rates. The complement of devaluation is revaluation.

A concept of devaluation is to bring the exchange rate in line with its long-run equilibrium level, i.e. a level consistent with international competitiveness.

Competitiveness is simply defined as the real exchange rate RER, where RER = (Pf/Pd)*NER. Where

NER → Nominal Exchange rate

Pf → is the price level prevailing in the foreign country (US)
Pd→ is the price level prevailing in the home country (Pakistan).

The formula implies that, for a fixed NET if inflation is higher in Pakistan (relative to
the US), Pakistani exports will become less attractive in the international market. As a result, our exports will fall, and current account will go into deficit.

To fix this problem, the NER can be devalued so as to make our goods cheaper and competitive and it is to bring competitiveness back to its original higher level. However, there are many provisos attached to the devaluation policy prescription.

Devaluation only works if the country’s exports and imports are elastic, otherwise the price effect of the devaluation will dominate the volume effect and the current account will worsen. Secondly, the country must have excess productive capacity in order to meet the higher demand for exports that is created as a result of the devaluation. Thirdly, the country should not have a very high foreign debt whose burden increases so much as a result of the

devaluation that the negative effects associated therewith overwhelm any positive competitiveness effects.

Capital account (+ or -)
+ → Incoming FDI, FPI or other private capital
- →Outgoing FDI, FPI or other private capital
+ → Borrowing, aid inflows
- →Payments of debt principal, aid outflows

Question No: 52 (Marks: 5)

Identify which of the following are stock variables and which are flow variables?

a) **Unemployment→Stock**
b) **Redundancies (job lay-offs)→Flow**
c) **Profits→Flow**
d) **A firm's stock market valuation (share price)→Stock**
e) **The value of property after a period of inflation→Stock**

(Marks: 1 for each)

Question No: 53 (Marks: 5)

World Bank suggests some structural reform policies for the poor countries to grow. Discuss those policies briefly.
Ans:

World Bank has suggested following policies for the poor countries to grow,

1. **Governance and administrative reforms:** To reduce over employment in public sector, reduce wastes and to improve the quality and reliability of public services. To strengthen the administration of taxes, to eliminate the corruption. To decentralize the control of fiscal policy making. To enrich the legal and regulator framework.

2. **Privatization of state-owned enterprises:** Abbreviated as SOEs. These are influenced by political interference and it is one of the reasons

SOEs are considered inefficient. SOEs are also suffering form lack of competition, cost awareness and fear of bankruptcy.

3. **Financial liberalization:** It involves ending of financial repression policies including artificially low interest rates, credit rationing, restrictions on banking competition and government involvement in investment allocation

4. **Liberalization of prices, removal of subsidies**

5. **Deregulation involving dismantling of licensing systems and red-tape**

6. **Trade liberalization:** including tariffication of non-tariff-barriers, harmonization of tariffs and an eventual reduction thereof

7. **FDI liberalization:** To create a transparent, predictable environment for foreign investors to operate in.

8. **Capital account liberalization:** To remove controls on capital flows

These policies are suggested by world bank and the successful implementation of these policies depend on the political and economic system of poor countries. In general these policies are expected to provide the poor nation with better understanding and help them to raise their growth.

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CS502 Fundamentals of Algorithms
Final TERM Subjective

Differentiate between back edge and forward edge Suppose you could prove that an NP-complete problem can not be solved in polynomial time. What would be the consequence?
Answer:

Back Edge
A **back edge** connects a vertex to an ancestor in a DFS-tree. Note that a self-loop is a back edge.
from descendent to ancestor
(u, v) where v is an ancestor of u in the tree.
DFS tree may only have a single back edge
A back edge is an arc whose head dominates its tail (tail -> head)
a back edge must be a part of at least one loop

Forward Edge

from ancestor to descendent
(u, v) where v is a proper descendent of u in the tree.
A **forward edge** is a non-tree edge that connects a vertex to a descendent in a DFS-tree.
Edge x-y is less than the capacity there is a forward edge x-y with a capacity equal to the capacity and the flow

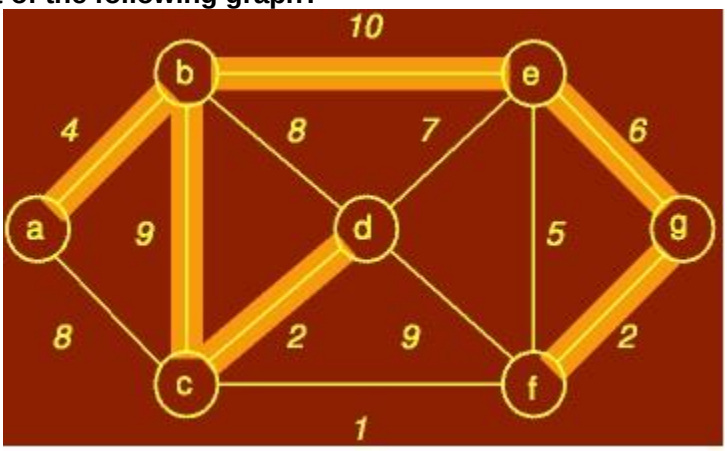
According to the question this means that the problem can be solved in Polynomial time using known NP problem can be solved using the given problem with modified input (an NP problem can be reduced to the given problem) then the problem is NP complete.
The main thing to take away from an NP-complete problem is that it cannot be solved in polynomial time in any known way. NP-Hard/NP-Complete is a way of showing that certain classes of problems are not solvable in realistic time.
Ref: Handouts Page No.128

Recursive explanation of dynamic programming.
Formulate the problem into smaller sub problems, find optimal solution to these sub problems in a bottom up fashion then write an algorithm to find the solution of whole problem starting with base case and works it way up to final solution.

Answer:
Dynamic programming is essentially recursion without repetition. Developing a dynamic programming algorithm generally involves two separate steps:

Formulate problem recursively. Write down a formula for the whole problem as a simple combination of answers to smaller sub problems.
Build solution to recurrence from bottom up. Write an algorithm that starts with base cases and works its way up to the final solution.
Ref: Handouts Page No.75

What is the cost of the following graph?



Cost =33

Answer:
A common problem is communications networks and circuit design is that of connecting together a set of nodes by a network of total minimum length. The length is the sum of lengths of connecting wires.

Consider, for example, laying cable in a city for cable t.v.

The computational problem is called the *minimum spanning tree* (MST) problem.
Formally, we are given
a connected, undirected graph G = (V, E) Each edge (u, v) has numeric weight of cost.
We define the cost of a spanning tree T to be the sum of the costs of edges in the spanning tree

$$w(T) = \sum_{(u,v)2T} w(u, v)$$

A minimum spanning tree is a tree of minimum weight The first is a spanning tree but is not a MST;
Ref: Handouts Page No.142

Let the adjacency list representation of an undirected graph is given below. Explain what general property of the list indicates that the graph has an isolated vertex.

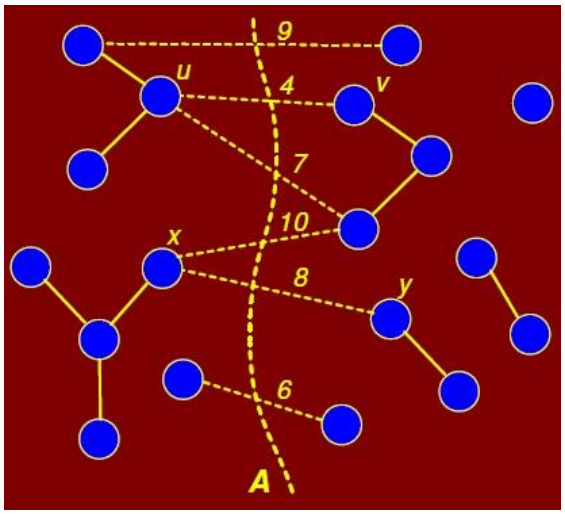
a → b → c → e
b → a → d
c → a → d → e → f
d → b → c → f
e → a → c → f
f → c → d → e
g

Answer:-

The main theorem which drives both algorithms is the following:

MST Lemma: Let G = (V, E) be a connected, undirected graph with real-valued weights on the edges.

Let A be a viable subset of E (i.e., a subset of some MST). Let (S, V − S) be any cut that respects A and let (u, v) be a light edge crossing the cut. Then the edge (u, v) is safe for A.



MST Proof: It would simplify the proof if we assume that all edge weights are distinct. Let T be any MST for G. If T contains (u, v) then we are done. This is shown in Figure 8.47 where the lightest edge (u, v) with cost 4 has been chosen.

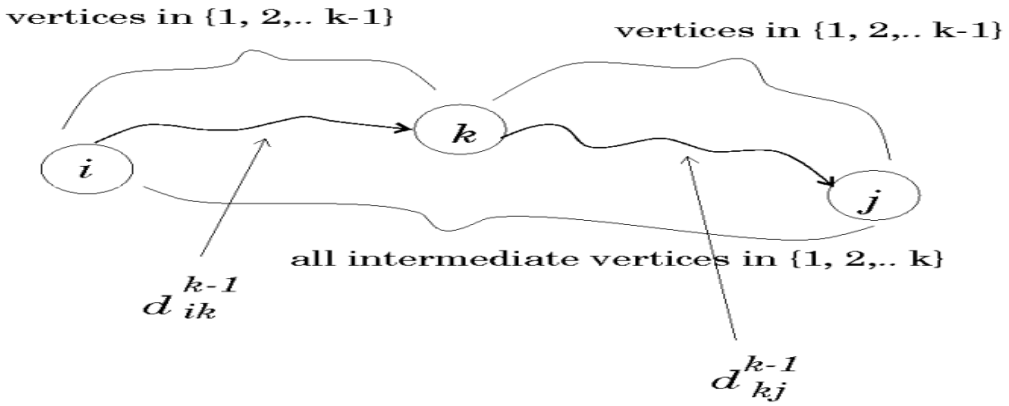
Ref: Handouts Page No.144

Floyd Warshal algorithm with three recursive steps

1. **Wij = 0 if I = j**
2. **Wij = w(i,j) if i != j and (i,j) belongs to E**
3. **Wij = infinity if i != j and (i,j) not belongs to E**

Answer

The Floyd-Warshall algorithm: Step (i)



The Floyd-Warshall algorithm: Step (ii)

Recursively define the value of an optimal solution.

Boundary conditions: for k = 0, a path from vertex i to j with no intermediate vertex numbered higher than 0 has no intermediate vertices at all, **hence d (0)= wij**

Recursive formulation:

$$d\frac{(k)}{ij} = \begin{Bmatrix} wij \\ \min(d\frac{(k-1)}{ij}, d\frac{(k-1)}{ik} + d\frac{(k-1)}{kj}) if k \geq 1 \end{Bmatrix}$$

$$\frac{D^{(n)} = (d^{(n)}ij\ )}{d^{(n)}ij\ = \sigma(i,j).}$$ **is the solution for this APSP problem:**

The Floyd-Warshall algorithm: Step (iii)

Compute the shortest-path weights bottom up

FLOYD-WARSHALL(W, n)

{

$\mathbf{D}^{(0)} = W;$

for k ≔ **1 to n**

for i ≔ **1 to n**

for j ≔ **1 to n**

$\mathbf{D}_{ij}^{(k)} := \min(d_{ij}^{(k-1)}, d_{ik}^{(k+1)}, +d_{kj}^{(k-1)},)$

$return\mathbf{D}^{(n)};$

}

$complexity\Theta(n^3).$

Ref: Handouts Page No.161

Give a detailed example for 2d maxima problem
Answer:-
The problem with the brute-force algorithm is that it uses no intelligence in *pruning* out decisions.

For example, once we know that a point pi is dominated by another point pj, we do not need to use pi for eliminating other points. This follows from the fact that dominance relation is *transitive*. If pj dominates pi and pi dominates ph then pj also dominates ph; pi is not needed.
Ref: Handouts Page No.17

How the generic greedy algorithm operates in minimum spanning tree?
Answer:-
A generic greedy algorithm operates by repeatedly adding any safe edge to the current spanning tree. When is an edge safe? Consider the theoretical issues behind determining whether an edge is safe or not.

Let S be a subset of vertices S _ V. A cut (S, V − S) is just a partition of vertices into two disjoint subsets. An edge (u, v) crosses the cut if one endpoint is in S and the other is in V − S. Given a subset of edges A, a cut respects A if no edge in A crosses the cut. It is not hard to see why respecting cuts are important to this problem. If we have computed a partial MST and we wish to know which edges can be added that do not induce a cycle in the current MST, any edge that crosses a respecting cut is a possible candidate.
Ref: Handouts Page No.143

What are two cases for computing

Answer:-
There are two cases for computing Lij the match case if ai = bj , and the mismatch case if ai 6= bj . In the match case, we do the following:

$$L_j^{\,i} = Inserta_j \,\mathrm{int}\, oL_j^{\,i-1},$$

and in the mismatch case, we do the following:

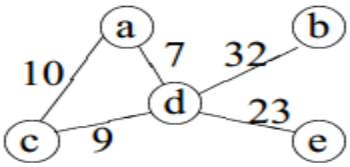
$$L_j^{\,i} = merge(L_{j-1}^{\,i}, L_j^{\,i-1}).$$

Ref: Handouts Page No.143

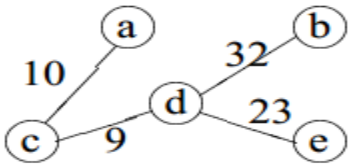
Describe Minimum Spanning Trees Problem with examples.
Problem
Given a connected weighted undirected graph, design an algorithm that outputs a minimum spanning tree (MST) of

Examples

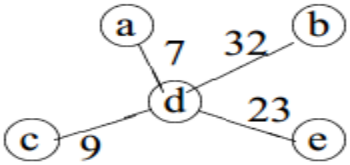
The graph is a complete, undirected graph G = (V, E ,W), where V is the set of pins, E is the set of all possible interconnections between the pairs of pins and w(e) is the length of the wire needed to connect the pair of vertices



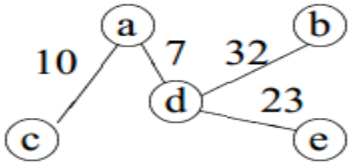
weighted graph



Tree 1. w=74



Tree 2, w=71



Tree 3, w=72

Minimum spanning tree

Ref: Handouts Page No.142

What is decision problem, also explain with example?

A decision problem is a question in some formal system A problem is called a decision problem if its output is a simple “yes” or “no” (or you may this of this as true/false, 0/1, accept/reject.) We will phrase may optimization problems as decision problems.

For example,

the MST decision problem would be: Given a weighted graph G and an integer k, does G have a spanning tree whose weight is at most k?

Ref: Handouts Page No.170

Do you think greedy algorithm gives an optimal solution to the activity scheduling problem?

The greedy algorithm gives an optimal solution to the activity scheduling problem.

Proof:

The proof is by induction on the number of activities. For the basis case, if there are no activities, then the greedy algorithm is trivially optimal. For the induction step, let us assume that the greedy algorithm is optimal on any set of activities of size strictly smaller than |S| and we prove the result for S. Let S0 be the set of activities that do not interfere with activity a1, That is

$$S' = \{ai \in S \mid si \geq f1\}$$

Any solution for S0 can be made into a solution for S by simply adding activity a1, and vice versa. Activity a1 is in the optimal schedule (by the above previous claim). It follows that to produce an optimal schedule for the overall problem, we should first schedule a1 and then append the optimal schedule for S0. But by induction (since |S0| < |S|), this exactly what the greedy algorithm does.

Ref: Handouts Page No.109

Define Forward edge

The most natural result of a depth first search of a graph (if it is considered as a function rather than procedure) is a spanning tree of the vertices reached during the search. Based on this spanning tree, the edges of the original graph can be divided into three classes: forward edges (or "discovery edges"), which point from a node of the tree to one of its descendants,

Ref: Handouts Page No.129 130

Is there any relationship between number of back edges and number of cycles in DFS?

Answer:

The time stamps given by DFS allow us to determine a number of things about a graph or digraph. we can determine whether the graph contains any cycles.

Lemma: Given a digraph G = (V, E), consider any DFS forest of G and consider any edge (u, v) 2 E. If this edge is a tree, forward or cross edge, then f[u] > f[v]. If this edge is a back edge, then f[u] _ f[v].

Proof: For the non-tree forward and back edges the proof follows directly from the parenthesis lemma. For example, for a forward edge (u, v), v is a descendent of u and so v's start-finish interval is contained within u's implying that v has an earlier finish time. For a cross edge (u, v) we know that the two time intervals are disjoint. When we were processing u, v was not white (otherwise (u, v) would be a tree edge), implying that v was started before u. Because the intervals are disjoint, v must have also finished before u.

Ref: Handouts Page No.130

What is the common problem in communications networks and circuit designing?

Answer:

A common problem is communications networks and circuit design is that of connecting together a set of nodes by a network of total minimum length. The length is the sum of lengths of connecting wires.

Consider, for example, laying cable in a city for cable t.v.

Ref: Handouts Page No.142

Explain the following two basic cases according to Floyd-Warshall Algorithm,

1. Don t go through vertex k at all.
2. Do go through vertex k.

Answer:-

Don't go through k at all

Then the shortest path from i to j uses only intermediate vertices {1, 2, . . . , k − 1}. Hence the length of
the shortest is $d_{ij}^{(k-1)}$

Do go through k

First observe that a shortest path does not go through the same vertex twice, so we can assume that we
pass through k exactly once. That is, we go from i to k and then from k to j. In order for the overall path to be as short as possible, we should take the shortest path from i to k and the shortest path from k to j.

Since each of these paths uses intermediate vertices {1, 2, . . . , k − 1}, the length of the path is

$$d_{ik}^{(k-1)} + d_{kj}^{(k-1)}$$

Ref: Handouts Page No.162

Show the result of time stamped DFS algorithm on the following graph. Take node A as a starting node.

Answer:-

Depth-first search (DFS) :

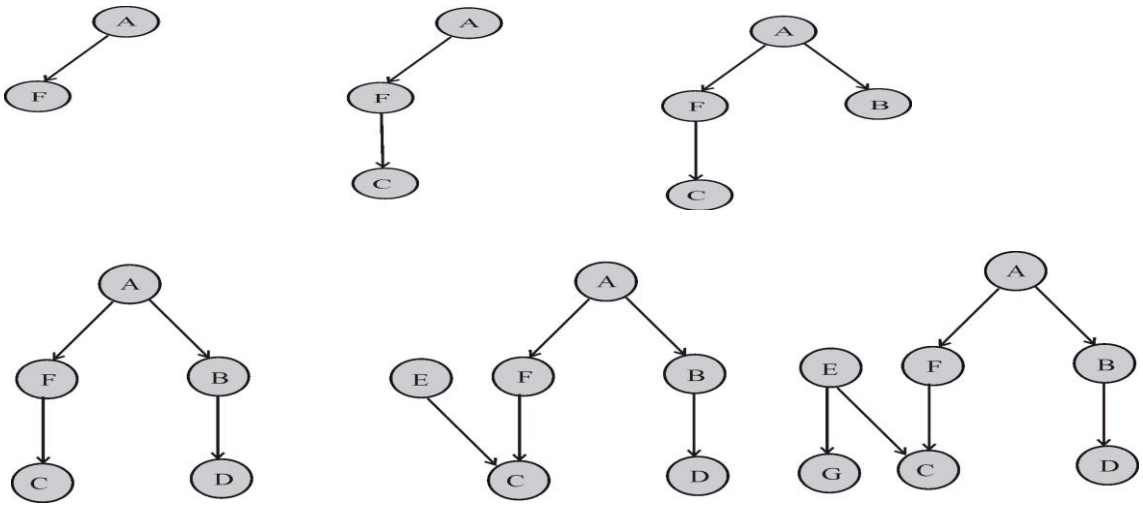
It is an algorithm for traversing or searching a tree, tree structure, or graph. Intuitively, one starts at the root (selecting some node as the root in the graph case) and explores as far as possible along each branch before backtracking.

Formally, DFS is an uninformed search that progresses by expanding the first child node of the search tree that appears and thus going deeper and deeper until a goal node is found, or until it hits a node that has no children. Then the search backtracks, returning to the most recent node it hadn't finished exploring. In a non-recursive implementation, all freshly expanded nodes are added to a LIFO stack for exploration.

```
 DFS (graph)
{
  list L =empty
  tree T =empty
 choose a starting vertex x
 search(x)
  while(Lis not empty)
 {
    remove edge (v, w) from beginning of L
      if w not yetvisited
```

```
    {
      add (v, w) to T
      search(w)
    }
  }
}

search(vertex v)
{
  visit v
  for each edge (v, w)
  add edge (v, w) to the beginning of L
}
```



Ref: http://www.chegg.com/homework-help/questions-and-answers/result-time-stamped-dfs-algorithm-followinggraph-node-starting-node-stronglyconnected-comp-q96642

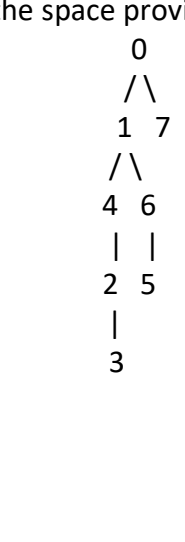
Why we need reduction?
Answer:-
The class NP-complete (NPC) problems consists of a set of decision problems (a subset of class NP) that no one knows how to solve efficiently. But if there were a polynomial solution for even a single NP-complete problem, then ever problem in NPC will be solvable in polynomial time. For this, we need the concept of reductions.
Ref: Handouts Page No.173

Consider the digraph on eight nodes, labeled 1 through 8, with eleven directed edges 1 2, 1 4, 2 4, 3 2, 4 5, 5 3 ,5 6, 7 8, 7 1, 2 7,8 7
Answer:-

0-7 0-1 1-4 1-6 2-3 3-4 4-2 5-2 6-0 6-3 6-5 7-1 7-3

Draw the DFS tree for the standard adjacency-matrix representation. List the edges of each type in the space provided below.

0-7 tree
0-1 tree
1-4 tree
1-6 tree
2-3 tree
3-4 back
4-2 tree
5-2 cross
6-0 back
6-3 cross
6-5 tree
7-1 cross
7-3 cross



Ref
http://www.cs.princeton.edu/courses/archive/fall04/cos226/exams/fin-s01-sol.html

Prove that the generic TRAVERSE (S) marks every vertex in any connected graph exactly once and the set of edges (v, parent (v)) with parent (v) ¹F form a spanning tree of the graph

Answer:-

Generic Traverse

- Suppose we want to visit every node in a connected graph (represented either explicitly or implicitly)
- The simplest way to do this is an algorithm called depth-first search
- We can write this algorithm recursively or iteratively - it's the same both ways, the iterative version just makes the stack explicit
- Both versions of the algorithm are initially passed a source vertex v

Lemma

Traverse(s) marks each vertex in a connected graph exactly once, and the set of edges (v, parent(v)), with parent(v) not nil, form a spanning tree of the graph.

Proof

- Call an edge (v, parent(v)) with parent(v) =6 nil a parent edge.
- Note that since every node is marked, every node has a parent edge except for s.
- It now remains to be shown that the parent edges form a spanning tree of the graph

Ref http://www.cs.unm.edu/~saia/362-s08/lec/lec18-2x2.pdf

What is a run time analysis and its two criteria
Answer:-
The main purpose of our mathematical analysis will be measuring the execution time. The running time of an implementation of the algorithm would depend upon the speed of the computer, programming language, optimization by the compiler etc. Two criteria for measuring running time are worst-case time and average-case time.
Worst-case time is the maximum running time over all (legal) inputs of size n. Let I denote an input instance, let |I| denote its length, and let T(I) denote the running time of the algorithm on input I. Then

$$T_{worst}(n) = \max_{|I|=n} T(I)$$

Average-case time is the average running time over all inputs of size n. Let p(I) denote the probability of seeing this input. The average-case time is the weighted sum of running times with weights being the probabilities:

$$T_{avg}(n) = \sum_{|I|=n} p(I)T(I)$$

We will almost always work with worst-case time. Average-case time is more difficult to compute; it is difficult to specify probability distribution on inputs. Worst-case time will specify an upper limit on the running time.
Ref: Handouts Page No.173

Dijkstra algorithm correctness criteria two conditions
Answer:
We will prove the correctness of Dijkstr's algorithm by Induction. We will use the definition that _(s, v)
denotes the minimal distance from s to v.
For the base case
1. S = {s}
2. d(s) = 0, which is _(s, s
Ref: Handouts Page No.158

Compare bellman ford algorithm with dijikstr's algorithm. Also give the time complexity of bellman ford algorithm (3 marks)

Answer:

Dijkstra's single-source shortest path algorithm works if all edges weights are non-negative and there are no negative cost cycles. Bellman-Ford allows negative weights edges and no negative cost cycles. The algorithm is slower than Dijkstra's, running in _(VE) time. Like Dijkstra's algorithm, Bellman-Ford is based on performing repeated relaxations. Bellman-Ford applies relaxation to every edge of the graph and repeats this V − 1 times.

Ref: Handouts Page No.159

psedo code of timestamp DFS

Answer:

```
DFS(G)
1 for (each u 2 V)
2 do color[u]   white
3 pred[u]   nil
4 time   0
5 for each u 2 V
6 do if (color[u] = white)
7 then DFSVISIT(u)
```

Ref: Handouts Page No.126

variants of shortest path solution

Answer

There are a few variants of the shortest path problem.

Single-source shortest-path problem: Find shortest paths from a given (single) source vertex s 2 V to every other vertex v 2 V in the graph G.

Single-destination shortest-paths problem: Find a shortest path to a given destination vertex t from each vertex v. We can reduce the this problem to a single-source problem by reversing the direction of each edge in the graph.

Single-pair shortest-path problem: Find a shortest path from u to v for given vertices u and v. If we solve the single-source problem with source vertex u, we solve this problem also. No algorithms for this problem are known to run asymptotically faster than the best single-source algorithms in the worst case.

All-pairs shortest-paths problem: Find a shortest path from u to v for every pair of vertices u and v. Although this problem can be solved by running a single-source algorithm once from each vertex, it can usually be solved faster.

Ref: Handouts Page No.153

Prove the following lemma,
Lemma: Given a digraph G = (V, E), consider any DFS forest of G and consider any edge (u, v) ∈E. If this edge is a tree, forward or cross edge, then f[u] > f[v]. If this edge is a back edge, then f[u] ≤ f[v]

Answer:-
Proof: For the non-tree forward and back edges the proof follows directly from the parenthesis lemma. For example, for a forward edge (u, v), v is a descendent of u and so v's start-finish interval is contained within u's implying that v has an earlier finish time. For a cross edge (u, v) we know that the two time intervals are disjoint. When we were processing u, v was not white (otherwise (u, v) would be a tree edge), implying that v was started before u. Because the intervals are disjoint, v must have also finished before u.

RAM(Random Access memory)and its Applications?
Answer:
A RAM is an idealized machine with an infinitely large random-access memory. Instructions are executed one-by-one (there is no parallelism). Each instruction involves performing some basic operation on two values in the machines memory. Basic operations include things like assigning a value to a variable, computing any basic arithmetic operation (+, - , × , integer division) on integer values of any size, performing any comparison (e.g. x _
Ref: Handouts Page No.10

Describe Dijkstra's algorithm working?
Answer
Dijkstra's algorithm works on a weighted directed graph G = (V, E) in which all edge weights are non-negative, i.e., w(u, v) _ 0 for each edge (u, v) 2 E.
Ref: Handouts Page No.154

Prim algorithm graph?
Answer
Prim's algorithm builds the MST by adding leaves one at a time to the current tree. We start with a root vertex r; it can be any vertex. At any time, the subset of edges A forms a single tree. We look to add a single vertex as a leaf to the tree.
Ref: Handouts Page No.149

write suedo code of relaxing a vertex 5
Answer
RELAX((u, v))
1 if (d[u] + w(u, v) < d[v])
2 then d[v] d[u] + w(u, v)
3 pred[v] = u
Ref: Handouts Page No.155

Define NP completeness

Answer:

The set of NP-complete problems is all problems in the complexity class NP for which it is known that if anyone is solvable in polynomial time, then they all are. Conversely, if anyone is not solvable in polynomial time, then none are.

Definition: A decision problem L is NP-Hard if

L0 _P L for all L0 2 NP.

Definition: L is NP-complete if

1. L 2 NP and
2. L0 _P L for some known NP-complete problem L0.

Ref: Handouts Page No.176

Define DAG

A directed graph that is acyclic is called a directed acyclic graph (DAG).

Ref: Handouts Page No.116

How Kruskal's algorithm works ?

Answer:

Kruskal's algorithm works by adding edges in increasing order of weight (lightest edge first). If the next edge does not induce a cycle among the current set of edges, then it is added to A. If it does, we skip it and consider the next in order. As the algorithm runs, the edges in A induce a forest on the vertices. The trees of this forest are eventually merged until a single tree forms containing all vertices.

Ref: Handouts Page No.147

What are two steps generally involved while developing a dynamic programming algorithm?

Answer:

Dynamic programming is essentially recursion without repetition. Developing a dynamic programming algorithm generally involves two separate steps:

Formulate problem recursively. Write down a formula for the whole problem as a simple combination of answers to smaller sub problems.

Build solution to recurrence from bottom up. Write an algorithm that starts with base cases and works its way up to the final solution.

Ref: Handouts Page No.75

The following adjacency matrix represents a graph that consists of four vertices labeled 0, 1, 2 and 3. The entries in the matrix indicate edge weights.

	0	1	2	3
0	0	1	0	3
1	2	0	4	0
2	0	1	0	1
3	2	0	0	0

Answer

NO. Because number of rows and number of columns are always same.

What is the application of edit distance technique?

Answer

Edit Distance: Applications

There are numerous applications of the Edit Distance algorithm. Here are some examples:

Spelling Correction

If a text contains a word that is not in the dictionary, a 'close' word, i.e. one with a small edit distance, may be suggested as a correction. Most word processing applications, such as Microsoft Word, have spelling checking and correction facility. When Word, for example, finds an incorrectly spelled word, it makes suggestions of possible replacements.

Plagiarism Detection

If someone copies, say, a C program and makes a few changes here and there, for example, change variable names, add a comment of two, the edit distance between the source and copy may be small. The edit distance provides an indication of similarity that might be too close in some situations.

Computational Molecular Biology

Speech Recognition

Algorithms similar to those for the edit-distance problem are used in some speech recognition systems. Find a close match between a new utterance and one in a library of classified utterances.

Ref: Handouts Page No.76

CS502

SOLVED SUBJECTIVE

FINAL TERM

1) In strong components problem what complete refers to?

Ans: Complete in the sense that that it is possible from any location in the network to reach any other location in the digraph**.**

2) How shortest path information is propagated in graph using Bell-Ford algorithm?

ANS. Bellman-Ford algorithm, solves the single-source shortest-paths problem allow negative-weight edges in the in-put graph and produce a correct answer as long as no negative-weight cycles are reachable from the source. Bellman-ford is based on performing repeated relaxation .Bellman ford applies relaxation to every edge of the graph and repeats this V-1 times**.**

3) How can we make it possible for an array of "n" elements that every element has equal probability of '1/n' to be selected as pivot elements?

4) Define according to KrusKal" s algorithm

a) Create set(u) create a set containing a single item u.
b) Find set(u) Find the set that contains u
c) Union (u, v) merge the set containing u and set containing v into a common set.

5) Write the indicates that the graph is complete?

Ans: Acomplete graphis an undirected graph in which every pair of vertices is adjacent

6) What is the recurrence relation for binary search and give some details for it and write asymptotic analysis at end?

7) Prove the Lemma:

Consider a diagraph G = (V,E) and any DFS forest for G. G has a cycle if and only if the DFS forest has a back edges ?

Ans: If there is back edge (u,v) then v is an ancestor of u and by tree edges from u to v we get a cycle . we show the contra positive suppose there are no back edges .by the lemma above each of the remaining types of edges ,tree, forward and cross all have the property that they go from vertices with higher finish time to the vertices with lower finish time .thus along any path finish times decrease monotonically implying there can be no cycle.

Difference b/w back ward and forward 2 marks

Ans Back edges are those edges.(u,v) where v is an ancestor of u in a depth-first tree. .

. Forward edges are those non tree edges.(u,v) where v is a proper descendant of u in a depth-first tree.

Polynomial time algorithm 2 marks

ANS:A polynomial time algorithm is any algorithm that runs in o(n k) time .A problem is solvable in polynomial time if there is a polynomial time algorithm for it.

Describe Minimum Spanning Trees Problem with examples. 2 marks

ans; A common problem is communications networks ans circuit design is that of connecting together a set of nodes by network of total minimum length .The length is the sum of lengths of connecting wires. the computational problem is called minimum spanning tree(MST) problem. A MST is a tree of minimum weight.

3n^2+7n-12 ke lower or upper bound solve kana tha 3 marks

Code of fib memorization . 3 marks

Ans. FIB(n)

1 if (n < 2)

2 then return n

3 else return FIB(n − 1) + FIB(n − 2)

write iterative dfs lgorithm?5 marks

ans ITERATIVE DFS(s)

1 PUSH(s)

2 while stack not empty

3 do v ← POP()

4 if v is unmarked

5 then mark v

6 for each edge (v, w)

7 do PUSH(w)

Q No.1 Suppose you could prove that an NP-complete problem can not be solved in polynomial time. What would be the consequence?

Ans: The importance of NP-complete problems should now be clear. If any NP-complete problem is solvable

in polynomial time, then every NP-complete problem is also solvable in polynomial time. Conversely, if

we can prove that any NP-complete problem cannot be solved in polynomial time, the every

NP-complete problem cannot be solvable in polynomial time.

Q No.2 Let the adjacency list representation of an undirected graph is given below. Explain what general property of the list indicates that the graph has an isolated vertex.

a □ b □ c □ e b □ a □ d c □ a □ d □ e □ f
d □ b □ c □ f e □ a □ c □ f f □ c □ d □ e g

Q No.3 What are two cases for computing?

ANS

Describe Dijkstra's algorithm working?

ANS: Dijkstra's algorithm works on a weighted directed graph G = (V, E) in which all edge

weights are non-negative, i.e., w(u, v) _ 0 for each edge (u, v) 2 E.

Q No.4 The following adjacency matrix represents a graph that consists of four vertices labeled 0, 1, 2 and 3. The entries in the matrix indicate edge weights.

	0	1	2	3
0	0	1	0	3
1	2	0	4	0
2	0	1	0	1
3	2	0	0	0

ANS: NO. Because number of rows and number of columns are always same

Q No.5 In the solution of edit distance technique, please describe two solution given (i) MATHS (ii) ARTS

ANS:

Q No.6 Variants of shortest path solution briefly?

ANS: There are a few variants of the shortest path problem.

Single-source shortest-path problem: Find shortest paths from a given (single) source vertex s 2 V to every other vertex v 2 V in the graph G.

Single-destination shortest-paths problem: Find a shortest path to a given destination vertex t from each vertex v. We can reduce the this problem to a single-source problem by reversing the direction of each edge in the graph.

Single-pair shortest-path problem: Find a shortest path from u to v for given vertices u and v. If we solve the single-source problem with source vertex u, we solve this problem also. No algorithms for this problem are known to run asymptotically faster than the best single-source algorithms in the worst case.

All-pairs shortest-paths problem: Find a shortest path from u to v for every pair of vertices u and v. Although this problem can be solved by running a single-source

algorithm once from each vertex, it can usually be solved faster.

Ref: Handouts Page No.153

Q No.7 Explain the following two basic cases according to Floyd-Warshall Algorithm,?

ANS There are two basic cases:

1. Don't go through vertex k at all

Then the shortest path from i to j uses only intermediate vertices {1, 2, . . . , k − 1}. Hence the length of the shortest Is d (k-1) ij

2. Do go through vertex k.

First observe that a shortest path does not go through the same vertex twice, so we can

assume that we pass through k exactly once. That is, we go from i to k and then from k to j. In order for the overall path to be as short as possible, we should take the shortest path from i to k and the shortest path from k to j Since each of these paths uses intermediate vertices {1, 2, . . . , k − 1}, the length of the path is (1) (1) kk dd ik kj □

Ref: Handouts Page No.162

Q No.8 Explain the topological sort?

Ans: A topological sort of a DAG is a linear ordering of the vertices of the DAG such that for each edge (u, v),u appears before v in the ordering. Computing a topological ordering is actually quite easy, given a DFS of the DAG. For every edge (u, v) in a DAG, the finish time of u is greater than the finish time of v (by the lemma). Thus, it suffices to output the vertices in the reverse order of finish times

Q No.9 Consider if point pi is dominated by another point pj, we do not need to use pi for eliminating other points. This follows from the fact that dominance relation is transitive. If pj dominates pi and pi dominates ph then pj also dominates ph; pi is not needed.
(Give the answer YES or NO)

working of dijkstra algorithm working

write two steps of dynamic programming

Dynamic programming is essentially recursion without repetition. Developing a dynamic programming algorithm generally involves two separate steps:

Formulate problem recursively. Write down a formula for the whole problem as a simple combination of answers to smaller sub problems.

Build solution to recurrence from bottom up. Write an algorithm that starts with base cases and works its way up to the final solution

pseoudo code for strong component?

Ans: sTRONGCOMPONENTS(G)

1 Run DFS(G) computing finish times f[u]

2 Compute GT

3 Sort vertices of GT in decreasing f[u]

4 Run DFS(GT) using this order

5 Each DFS tree is a strong component

hum nay ak railway track bishana hy hum konsa algorithm select krain gay k hum minimum track kar sakian

write code of dikstra algorith ?

ans:

DIJKSTRA((G, w, s))

1 for (each u belong V)

2 do d[u] ← ∞

3 pq.insert (u, d[u])

4 d[s] ← 0; pred [s] ← nil; pq.decrease key (s, d[s]);

5 while (pq.not empty ())

6 do u ← pq.extract min ()

7 for (each v ∈ adj[u])

8 do if (d[u] + w(u, v) < d[v])

9 then d[v] = d[u] + w(u, v)

10 pq.decrease key (v, d[v])

11 pred [v] = u

Difference b/w back ward and forward 2 marks (repeated)
Polynomial time algorithm 2 marks

A polynomial time algorithm is any algorithm that runs in O(nk) time.A problem is solvable in polynomial time if there is a polynomial time algorithm for it.

Describe Minimum Spanning Trees Problem with examples. 2 marks)(REPEATED)

Ak code given that us ka asymptotic notation bateni the. 3 marks
3n^2+7n-12 ke lower or upper bound solve kana tha 3 marks
Code OF fib memorization . 3 marks (REPEATE)
itterative step OF DFS: 5 marks

Q No.1 Suppose you could prove that an NP-complete problem can not be solved in polynomial time. What would be the consequence?(REPEATED)
Q No.2 Let the adjacency list representation of an undirected graph is given below. Explain what general property of the list indicates that the graph has an isolated vertex. a à b à c à e b à a à dc à a à d à e à fd à b à c à fe à a à c à ff à c à d à e g
Q No.3 What are two cases for computing Describe Dijkstra's algorithm working?
Q No.4 The following adjacency matrix represents a graph that consists of four vertices labeled 0, 1, 2 and 3. The entries in the matrix indicate edge weights.

	1	2	3
1			3
1	2		4
2		1		1
3	2		

Q No.5 In the solution of edit distance technique, please describe two solution given (i) MATHS (ii) ARTSQ No.6 Variants of shortest path solution briefly?Q No.7 Explain the following two basic cases according to Floyd-Warshall Algorithm,Q No.8 Explain the topological sort?
Q No.9 Consider if point pi is dominated by another point pj, we do not need to use pi for eliminating other points. This follows from the fact that dominance relation is transitive. If pj dominates pi and pi dominates ph then pj also dominates ph; pi is not needed. (Give the answer YES or NO)I forget other

1) Give Detail Example of 2-d mazama Problem

Suppose you want to buy a car. You want the pick the fastest car. But fast cars are expensive; you want the cheapest. You cannot decide which is more important: speed or price. Definitely do not want a car if there is another that is both faster andcheaper. We say that the fast, cheap car dominates the slow,expensive car relative to your selection criteria. So, given a collection of cars, we want to list those cars that are not dominated by any other.. • Let a point p in 2-dimensional space be given by its integer coordinates, p = (p.x, p.y). • A point p is said to be dominated by point q if $p.x \leq q.x$ and $p.y \leq q.y$.

• Given a set of n points, P = {p1, p2, . . . , pn} in 2-space a point is said to be maximal if it is notdominated by any other point in P.

The car selection problem can be modelled this way: For each car we associate (x, y) pair where x is the speed of the car and y is the negation of the price. High y value means a cheap car and low y means expensive car. Think of y as the money left in your pocket after you have paid for the car . Maximalpoints correspond to the fastest and cheapest cars.

The 2-dimensional Maxima is thus defined as

• Given a set of points P = {p1, p2, . . . , pn} in 2-space, output the set of maximal points of P, i.e.,those points pi such that pi is not dominated by any other point of P.
Where Clique Problem Arise?

ANS: The clique cover problem arises in applications of clustering. We put an edge between two nodes if theyare similar enough to be clustered in the same group. We want to know whether it is possible to cluster allthe vertices into k groups.

What is Decision Problem and give Examples

ANS: A problem is called a decision problem if its output is a simple "yes" or "no" (or you may this of this as true/false, 0/1, accept/reject.) We will phrase may optimization problems as decision problems.

explain with Flody Algorithm (Running time and Space used)?

Ans: Let G = (V, E) be a directed graph with edge weights. If (u, v) ∈ E is an edge then w(u, v) denotes itsweight. δ(u, v) is the distance of the minimum cost path between u and v. We will allow G to have negative edges weights but will not allow G to have negative cost cycles. We will present an Θ(n3) algorithm for the all pairs shortest path. The algorithm is called the Floyd-Warshall algorithm and is based on dynamic programming. the running time is Θ(n3). The space used by the algorithm is Θ(n2).

Fibonacci sequence 2mark

Ans: This sequence, in which each number is the sum of the two preceding numbers, has proved extremely fruitful and appears in many different areas of mathematics and science**. The Fibonacci** numbers F n are defined as follows:

F0 = 0

F1 = 1

Fn = Fn−1 + Fn−273

Clique cover problem 2mark

ans: Given a graph G and an integer k, can we find k subsets of vertices V1, V2, . . . , VK , such that SiVi = V , and that each Vi is a clique of G. The clique cover problem arises in applications of clustering. We put an edge between two nodes if they are similar enough to be clustered in the same group. We want to know whether it is possible to cluster all the vertices into k groups.

Communication design problem (MST).

ans: A common problem is communications networks and circuit design is that of connecting together a set of nodes by a network of total minimum length. The length is the sum of lengths of connecting wires.

Q: what is forest and free tree?

An acyclic, undirected graph is a forest, and a connected, acyclic, undirected graph is a(free) tree

Strong connected component problem?

Ans. Are the components fully connected?. A digraph is strongly connected if for every pair of vertices u, v in V , u can reach v and vice versa. We would like to write an algorithm that determines whether a digraph is strongly connected. In fact, we willsolve a generalization of this problem, of computing the strongly connected components of a digraph

Heapify? 5marks

Ans: There is one principal operation for maintaining the heap property. It is called Heapify. we are given an element of the heap which we suspect may not be in valid heap order, but we assume that all of other the elements in the subtree rooted at this element are in heap order. In particular this root element may be too small. To fix this we "sift" it down the tree by swapping it with one of its children. Which child? W e should take the larger of the two children to satisfy the heap ordering property. This continues recursively until the element is either larger than both its children or until its falls all the way to the leaf level

Dijkstra Algorithm?

ans: Dijkstra's algorithm is a simple greedy algorithm for computing the single-source shortest-paths to all other vertices. Dijkstra's algorithm works on a weighted directed graph G = (V, E) in which all edgeweights are non-negative, i.e., $w(u, v) \geq 0$ for each edge $(u, v) \in E$.

Define Floyd Marshall 5marks

Ans: Let G = (V, E) be a directed graph with edge weights. If $(u, v) \in E$ is an edge then w(u, v) denotes its weight. $\delta(u, v)$ is the distance of the minimum cost path between u and v. We will allow G to have negative edges weights but will not allow G to have negative cost cycles. We will present an $\Theta(n3)$algorithm for the all pairs shortest path. The algorithm is called the Floyd-Warshall algorithm and is based on dynamic programming. Formulation: Define $d(k)ij$ to be the shortest path from i to j such that any intermediate vertices on the path are chosen from the set {1, 2, . . . , k}. The path is free to visit any subset of these vertices and in any order. There are two basic cases:

1. Don't go through vertex k at all.

2. Do go through vertex k.

what is the running time and space used by Floyd Marshall 3marks

Ans: the running time is $\Theta(n3)$. The space used by the algorithm is $\Theta(n2)$. repeated

DFS algorithm 3marks

How we convert the shortest path problem into a single source problem? 2 Marks

Ans: Find a shortest path to a given destination vertex from each vertex . By reversing the direction of each edge in the graph, we can reduce this problem to a single-source problem

If problem A reduces (is polynomial-time reducible) to problem B and B is NP-complete then A is NP-complete ?

Ans. Yes because if np complete is reducible in polynomial then all can be in polynomial time.

Consider the following code:

```
For(j=1; j<n;j++)
For(k=1; k<15;k++)
For(l=5; l<n; l++)
{
Do_something_constant();
}
```

What is the order of execution for this code.?

An arbitrary graph with G(V,E) with E = |V|- I is a tree. true or false tell briefly 2 marks

ANS:Yes

Analysis of the brute-force maxima algorithm?

Ans: Assume that the input size is n, and for the running time we will count the number of time that any element of P is accessed. Clearly we go through the outer loop n times, and for each time through this loop, we go through the inner loop n times as well. The condition in the if-statement makes four accesses to P. The output statement makes two accesses for each point that is output. In the worst case every points maximal these two access are made for each time through the outer loop

Given a digraph G = (V, E), consider any DFS forest of G and consider any edge (u, v) 2 E. If this edge is a tree, forward or cross edge, then f[u] > f[v]. If this edge is a back edge, then f[u] _ f[v] ?

ANS: For the non-tree forward and back edges the proof follows directly from the parenthesis lemma.For example, for a forward edge (u, v), v is a descendent of u and so v's start-finish interval is contained within u' Is implying that v has an earlier finish time. For a cross edge (u, v) we know that the two time intervals are disjoint. When we were processing u, v was not white (otherwise (u, v) would be a tree edge), implying that v was started before u. Because the intervals are disjoint, v must have also finished before u.

Where the Clique Cover Problem arises 3 marks(repeated)

What is decision problem, also explain with example? 2 marks

ANS A problem is called a decision problem if its output is a simple "yes" or "no" (or you may this of this as true/false, 0/1, accept/reject.) We will phrase may optimization problems as decision problems. For example, the MST decision problem would be: Given a weighted graph G and an integer k, does G have a spanning tree whose weight is at most k

How Dijkstra's algorithm operates? 3

Ans: Dijkstra's algorithm is based on the notion of performing repeated relaxations. The algorithm operates by maintaining a subset of vertices, $S \subseteq V$, for which we claim we know the true distance, $d[v] = \delta(s, v)$.Initially $S = \emptyset$, the empty set. We set $d[u] = 0$ and all others to ∞. One by one we select vertices from $V - S$ to add to S.

write code of relaxing a vertex 5

Ans: RELAX((u, v))

1 if (d[u] + w(u, v) < d[v])

2 then d[v] ← d[u] + w(u, v)

3 pred[v] = u

Explain why the statement "The running time of A is at least On2 " is meaning less 5 Marks

Show the strongly connected components of the following graph using DFS algorithm. Take node E as a starting node. [You can show final result in exam software and need not to show all intermediate steps].5 marks

Q. Heap sort Algorithm?

Ans: We build a max heap out of the given array of numbers A[1..n]. We repeatedly extract the maximum item from the heap. Once the max item is removed, we are left with a hole at the root. To fix this, we will

replace it with the last leaf in tree We will apply a heapify procedure to the root to restore the heap.

Q. Difference between Back edge and cross edge. (REPEATED)

Q.HOW Prim's Algorithm builds the MST?

Ans: Prim's algorithm builds the MST by adding leaves one at a time to the current tree. We start with a root vertex r; it can be any vertex. At any time, the subset of edges A forms a single tree

Q. Do go through k & Dont go through k at all?

Ans

Don't go through k at all : Then the shortest path from i to j uses only intermediate vertices {1, 2, . . . , k − 1}. Hence the length of the shortest is d(k−1)ij

Do go through k : First observe that a shortest path does not go through the same vertex twice, so we can assume that we pass through k exactly once. That is, we go from i to k and then from k to j. In order for the overall path to be as short as possible, we should take the shortest path from i to k and the shortest path from k to j. Since each of these paths uses intermediate vertices {1, 2, . . . , k − 1}, the length of the path is d(k−1)ik+ d(k−1)kj

Q. BFS pseudo code in graph?

Ans:

TRAVERSE(s)

1 enqueue(∅, s)

2 while queue not empty

3 do dequeue(p, v)

4 if (v is unmarked)

5 then mark v

6 parent (v) ← p

7 for each edge (v, w)

8 do enqueue(v, w)

Q. heapify? REPEATED)

7. Prove that the generic TRAVERSE (S) marks every vertex in any connected graph exactly once and the set of edges (v, parent (v)) with parent (v) ¹F form a spanning tree of the graph.

Ans: Call an edge (v, parent(v)) with parent(v) 6 = ∅, a parent edge. For any node v, the path of parent edges v → parent(v) → parent(parent(v)) → . . . eventually leads back to s. So the set of parent edges form a connected graph .Clearly, both end points of every parent edge are marked, and the number of edges is exactly one less than the number of vertices. Thus, the parent edges form a spanning tree.

8. Apply Kruskal's algorithms on the following graph.[You can show final result in exam software and need not to show all intermediate steps].

1) polynomial time algorithm? (Repeated)
2) what is a run time analysis and its two criteria?

Ans:

The main purpose of run time analysis will be measuring the execution time. THE running time of an implementation of the algorithm would depend upon the speed of the computer, Two criteria for measuring running time are worst-case time and average-case time.

Worst-case time is the maximum running time over all (legal) inputs of size n. Let I denote an input instance, let |I| denote its length, and let T (I) denote the running time of the algorithm on input Average-case time is the average running time over all inputs of size n. Let p(I) denote the probability of seeing this input. The average-case time is the weighted sum of running times with weights being the probabilities:

3) Dijkstra algorithm correctness criteria two conditions?

Ans: the correctness of Dijkstr's algorithm by Induction. We will use the definition that δ(s, v)denotes the minimal distance from s to v.For the base case

1. S = {s}

2. d(s) = 0, which is δ(s, s)

4) Floyd algorithm (repeated)
5) a table is given and we have to make the adjacency list and matrix
6) an mst graph is given and we have to calculate its weigth?
-Q Describe depth-first search algorithm in graphs with iterative version.

Ans:

ITERATIVE DFS(s)

1 PUSH(s)

2 while stack not empty

3 do v ← POP()

4 if v is unmarked

5 then mark v

6 for each edge (v, w)

7 do PUSH(w)

- Where clique problem arises. (repeated)

- what is decision problem.expalin wd example.repeated
- find the minimum cost spanning tree.....diagram was given...
- there was given a recursive search function we have to the complexity of that search.
3 marks.....
-Q Floyd-warshall algorithem with respect to running time n spaced used.(repeated)
- Q how khurkal algorithm works?

Ans: Kruskal's algorithm works by adding edges in increasing order of weight (lightest edge first). If the next edge does not induce a cycle among the current set of edges, then it is added to A. If it does, we skip it and consider the next in order. As the algorithm runs, the edges in A induce a forest on the vertices. The trees of this forest are eventually merged until a single tree forms containing all vertices. This can be done using the Union-Find data structure which supports the following O(log n) operations:

Create-set(u): Create a set containing a single item u.

Find-set(u): Find the set that contains u

Union(u,v): merge the set containing u and set containing v into a common set.
- T/F:A sequence of matrix in column of dynamic problem table for a instance of knapsack is always non decreasing? explain briefly.
2 marks.....
-Q informal definition of algorithm.?

Ans: An algorithm is any well-defined computational procedure that takes some values, or set of values, as input and produces some value, or set of values, as output. An algorithm is thus a sequence of computational steps that transform the input into output
- differentiate farwrd n backwrd edge. (Repeated)
- how dijshkra algorithm operate. . (Repeated)

Q1) **answer the follwing according to Floyd Marshall 1) runing time 2) space use? . (Repeated)**

2) write suedo code of dijkstra algorithm? 5marks. (Repeated)

3)Give a detailed example for 2-d maxima problem 2marks . (Repeated)

4)Make Adjacency list from the given table 5marks. (Repeated)

5) how generic algorithms work with minimum spaning tree 3marks

Ans: A generic greedy algorithm operates by repeatedly adding any safe edge to the current spanning tree**.**
6) Floyd-Warshall matrix diya tha os py 3 itration apply karny thy 5marks (for example see page no 165 to167 on handouts. Figures)
7) Which points should be supposed to prove the correctness of the Dijkstra's Algorithm 3marks

Ans: Assume that d(v) = δ(s, v) for every v belong to S and all neighbors of v have been relaxed. If d(u) ≤ d(u 0)for every u' belong to then d(u) = δ(s, u), and we can transfer u from V to S, after which d(v) =

δ(s, v) for every v belong to S.

Fibonacci sequence 2mark (repeated)

Clique cover problem 2mark (repeated)

Make Adjacency list from the given table 3marks (repeated)

Communication design problem (MST).

Ans: A common problem is communications networks and circuit design is that of connecting together a set of nodes by a network of total minimum length. The length is the sum of lengths of connecting wires.

Strong connected component problem? repeated)

Heapify proof..... 5marks repeated)

Dijkstra Algorithmn repeated)

Define Floyd Marshall 5marks repeated)

what is the running time and space of Floyd Marshall 3marks repeated)

DFS algorithm 3marks repeated)

(1) give a detailed example of 2-d maxima ? repeated)

(2) what is common problem in communication networks and circuit designing? 2

Ans: A common problem is communications networks and circuit design is that of connecting together a set of nodes by a network of total minimum length

(3) write psuedo code of relaxing a vertex 5 repeated)

(4) write suedo code of dijkstra algorithm? 5 repeated)

(5) define NP completeness 5 repeated)

(6) define floyed warshall algorithm in these two cases 5 repeated)

do not go through a vertex k at all

do go through a vertex k

(7) Define DAG 3

Ans: A directed graph that is acyclic is called a directed acyclic graph (DAG)

4 Questions of 5 Marks

1) Write steps of sieve techniques?

ANS: The sieve technique works in phases as follows. It applies to problems where we are interested in finding a single item from a larger set of n items. We do not know which item is of interest, We select a random element of A partition A into three parts.

1. A[q] contains the pivot element x,

2. A[1..q − 1] will contain all the elements that are less than x and

3. A[q + 1..n] will contains all elements that are greater than x.

2) Write Psuedo code of Dijkstra's algorithm repeated)

3) Prove the Lemma:

Consider a diagraph G = (V,E) and any DFS forest for G. G has a cycle if and only if the DFS forest has a back edges repeated)

Where the clique cover problem is used?

Ans: The clique cover problem arises in applications of clustering. We put an edge between two nodes if they are similar enough to be clustered in the same group. We want to know whether it is possible to cluster all the vertices into k groups

What is decision problem, also explain with examples? repeated

4 Questions of 3 Marks

1) Let the adjacnecy list representation of an undirected graph is given.
Explaint what property of the list indicates that tha graph has an isolated vertex

	a	b	c	d	e	f
a	1	0	1	1	0	0
b	0	1	1	0	1	0
c	1	0	0	0	0	1
d	0	1	1	1	0	1
e	1	1	0	1	1	1
f	1	0	1	0	1	0
g	0	0	0	0	0	0

2) Analyze the brute force maxima algorithm
3) How Kruskal's algorithm works ?
4) Which points should be supposed to prove the correctness of the Dijkstra's Algorithm

4 Questions of 2 Marks

1) Given a matriz of graph G
Is G directed or undirected graph ?

	0	1	2	3
0	0	1	0	3
1	2	0	4	0
2	0	1	0	1
3	2	0	0	0

2) Give a detailed example of 2 d maxima
3) What is the common problem in communication network and circuit designing?
4) (4th question i forgot)

Fibonacci sequence 2mark repeated)

Clique cover problem 2mark repeated)

Make Adjacency list from the given table 3marks repeated)

Communication design problem (MST). repeated)

Strong connected component problem? repeated)

Heapify proof..... 5marks repeated)
Dijkstra Algorithmn
Define Floyd Marshall 5marks repeated)

Floyd Marshall 3marks repeated)
runtime
space used
DFS algoritmn 3marks repeated)

(1) give a detailed example of 2-d maxima ? repeated)

(2) what is common problem in communication networks and circuit designing? 2 repeated)
(3) write psuedo code of relaxing a vertex 5 repeated)
(4) write psuedo code of dijkstra algorithm? 5 repeated)
(5) define NP completeness 5 repeated)
(6) define floyed warshall algorithm in these two cases 5 repeated)

do not go through a vertex k at all
do go through a vertex k
(7) Define DAG 3 repeated)

10 marks: What is generic approach for computing MST? repeated)

10 marks: write the pseudo code algorithm for implementing knapsack using stack?
5 marks: you are given a task of laying railway tracks in Pakistan. You want that there should be minimum distance between any two cities. Which algorithm would you apply for this. 4 options were given Prim, Floyd-Warshall, Bellman-Ford and Dijkstra?

Ans: I will chose Floyd-Warshall and I also gave solid arguments for this**.**
3 marks: What is the running time of Floyd-Warshall algorithm? repeated)

1 mark: When we have objects in such a way that there is some interconnection or relationship among objects then what is the best way to model such situations.

Ans:GRAPHS is the best way to model the problem.
What is DFS?

Ans Another traversal strategy is depth-first search (DFS). The strategy followed by depth-first search is, as its name implies, to search“deeper” in the graph whenever possible. Depth-first search explores edges

out of the most recently discovered vertex that still has unexplored edges leaving it. Once all ofv's edges have been explored, the search "backtracks" to explore edges leaving the vertex from which vwas discovered. DFS procedure can be written recursively or non-recursively. Both versions are passed s initially.

Q.**When is a graph strongly connected graph?**

Ans: A digraph is strongly connected if for every pair of vertices u, v ∈ V , u can reach v and vice versa

5 marks: Prove the following lemma

Given a digraph G = (V, E), consider any DFS forest of G and consider any edge (u, v) 2 E. If this edge is a tree, forward or cross edge, then f[u] > f[v]. If this edge is a back edge, then f[u] <= f[v].

ans: For the non-tree forward and back edges the proof follows directly from the parenthesis lemma. For example, for a forward edge (u, v), v is a descendent of u and so v's start-finish interval is contained within u's implying that v has an earlier finish time. For a cross edge (u, v) we know that the two time intervals are disjoint. When we were processing u, v was not white (otherwise(u, v) would be a tree edge), implying that v was started before u. Because the intervals are disjoint, v must have also finished before u.

3 variants of shortest path algorithm?.....3(repeated)

Matrix was given ...we have to tell the general property of having loop.....3

Apply dijkstra algorithm on given graph.....5(repeated)

Q: how topological sort work??.....5

ans: A topological sort of a DAG is a linear ordering of the vertices of the DAG such that for each edge (u, v),u appears before v in the ordering .Computing a topological ordering is actually quite easy, given a DFS of the DAG. For every edge (u, v)in a DAG, the finish time of u is greater than the finish time of v (by the lemma). Thus, it suffices to output the vertices in the reverse order of finish times.

Q:**Pseudo code of topological sort.....10**

ans

```
TOPOLOGICALSORT(G)

1 for (each u ∈ V )

2 do color[u] ← white

3 L ← new Linked List()

4 for each u ∈ V

5 do if (color[u] = white)

6 then TOPVISIT(u)

7 return L
```

you are given a task of laying railway tracks in Pakistan. You want that there should be minimum distance between any two cities. Which algorithm would you apply for this. 4 options were given Prim, Floyd-Warshall, Bellman-Ford and Dijkstraa? (repeated)
Ans: I will chose Floyd-Warshall
Q:define unweighted graph?

ans: An un-weighted graph can be considered as a graph in which every edge has weight one unit.
what is common problem in network n circuit design?.....2(repeated)
Forward edge ??.

Ans: Forward Edge

from ancestor to descendent(u, v) where v is a proper descendent of u in the tree. A forward edge is a non-tree edge that connects a vertex to a descendent in a DFS-tree. Edge x-y is less than the capacity there is a forward edge x-y with a capacity equal to the capacity and the flow formula to compute encodings tree T.....1
(1)Is adjacency matrix faster than list to find the cost of an edge? Why and why not?
) Adjacency Matrix is better to locate edges as compared to list ; as matrix has direct entries for edges. Here you can think more about these data structures space wise "lists " will be preferable to store the graph information as matrix takes O(n^2) space while in Sparse graph means having less edges in it the lists will take less storage. It all depends upon the application for which you want to use the particular data structure

(2)As we know that huffman coding algorithm is a greedy approach. What is the theta notation for this algorithm? Is it polynomial time algorithm or exponential? Please explain

Yes it is polynomial time algorithm and it has time complexity up to O(n^2)..
(3)In directed graphs, what may be the maximum number of vertices?Any relation for this?Please explain it?

There may be as many vertices as possible for directed graph . You have not specified for which you want to ask relationship; however if it means the in degree and out degree of edges then the sum of all in degrees or out degrees will be equal to no of edges present in the graph ;here in degree means the no of edges coming to that particular vertex and out degree means the no of edges going out that particular vertex. IF YOU HAVE ASKED OTHER RELATION i.e. no edges and no vertices then this is not predictable as there may be random no of edges may go OUT and IN to the vertex.

(4)Breadth first search is shortest path algorithm that works on un-weighted graphs. Is depth first shortest path algorithm that works on un-weighted graphs?

Depth First Search also works for un-weighted AND WEIGHTED graphs as well

REMEMBER ME IN UR PRAYS:

CS502 Fundamentals of Algorithms
Final TERM Subjective

Differentiate between back edge and forward edge Suppose you could prove that an NP-complete problem can not be solved in polynomial time. What would be the consequence?
Answer:

Back Edge
A **back edge** connects a vertex to an ancestor in a DFS-tree. Note that a self-loop is a back edge.
from descendent to ancestor
(u, v) where v is an ancestor of u in the tree.
DFS tree may only have a single back edge
A back edge is an arc whose head dominates its tail (tail -> head)
a back edge must be a part of at least one loop

Forward Edge

from ancestor to descendent
(u, v) where v is a proper descendent of u in the tree.
A **forward edge** is a non-tree edge that connects a vertex to a descendent in a DFS-tree.
Edge x-y is less than the capacity there is a forward edge x-y with a capacity equal to the capacity and the flow

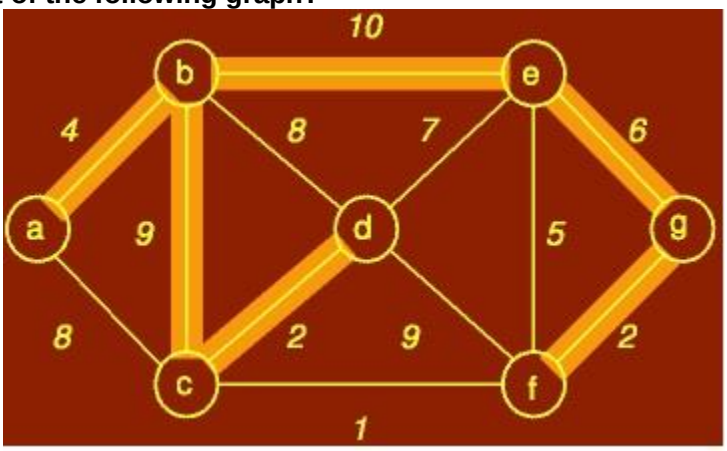
According to the question this means that the problem can be solved in Polynomial time using known NP problem can be solved using the given problem with modified input (an NP problem can be reduced to the given problem) then the problem is NP complete.
The main thing to take away from an NP-complete problem is that it cannot be solved in polynomial time in any known way. NP-Hard/NP-Complete is a way of showing that certain classes of problems are not solvable in realistic time.
Ref: Handouts Page No.128

Recursive explanation of dynamic programming.
Formulate the problem into smaller sub problems, find optimal solution to these sub problems in a bottom up fashion then write an algorithm to find the solution of whole problem starting with base case and works it way up to final solution.

Answer:
Dynamic programming is essentially recursion without repetition. Developing a dynamic programming algorithm generally involves two separate steps:

Formulate problem recursively. Write down a formula for the whole problem as a simple combination of answers to smaller sub problems.
Build solution to recurrence from bottom up. Write an algorithm that starts with base cases and works its way up to the final solution.
Ref: Handouts Page No.75

What is the cost of the following graph?



Cost =33

Answer:
A common problem is communications networks and circuit design is that of connecting together a set of nodes by a network of total minimum length. The length is the sum of lengths of connecting wires.

Consider, for example, laying cable in a city for cable t.v.

The computational problem is called the *minimum spanning tree* (MST) problem.
Formally, we are given
a connected, undirected graph G = (V, E) Each edge (u, v) has numeric weight of cost.
We define the cost of a spanning tree T to be the sum of the costs of edges in the spanning tree

$$w(T) = \sum_{(u,v)2T} w(u, v)$$

A minimum spanning tree is a tree of minimum weight The first is a spanning tree but is not a MST;
Ref: Handouts Page No.142

Let the adjacency list representation of an undirected graph is given below. Explain what general property of the list indicates that the graph has an isolated vertex.

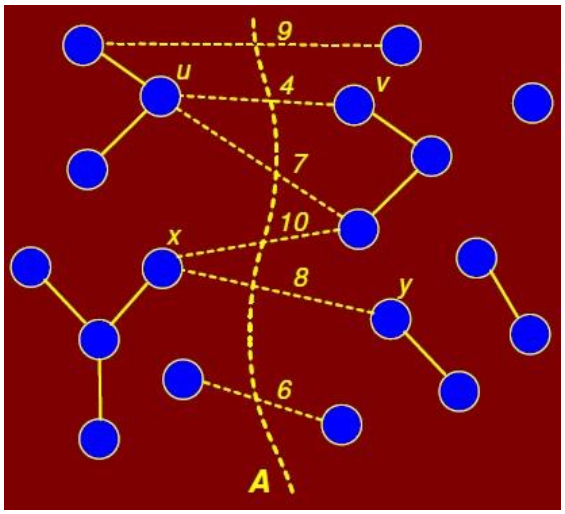
a → b → c → e
b → a → d
c → a → d → e → f
d → b → c → f
e → a → c → f
f → c → d → e
g

Answer:-

The main theorem which drives both algorithms is the following:

MST Lemma: Let G = (V, E) be a connected, undirected graph with real-valued weights on the edges.

Let A be a viable subset of E (i.e., a subset of some MST). Let (S, V − S) be any cut that respects A and let (u, v) be a light edge crossing the cut. Then the edge (u, v) is safe for A.



MST Proof: It would simplify the proof if we assume that all edge weights are distinct. Let T be any MST for G. If T contains (u, v) then we are done. This is shown in Figure 8.47 where the lightest edge (u, v) with cost 4 has been chosen.

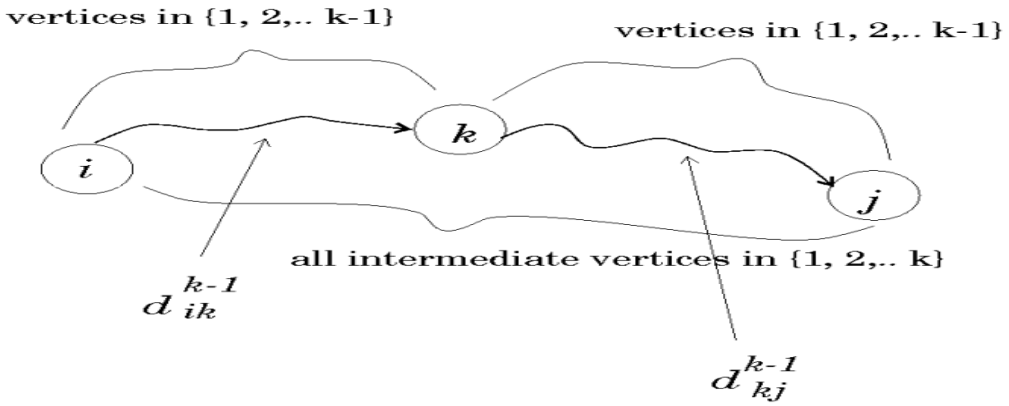
Ref: Handouts Page No.144

Floyd Warshal algorithm with three recursive steps

1. **Wij = 0 if I = j**
2. **Wij = w(i,j) if i != j and (i,j) belongs to E**
3. **Wij = infinity if i != j and (i,j) not belongs to E**

Answer

The Floyd-Warshall algorithm: Step (i)



The Floyd-Warshall algorithm: Step (ii)

Recursively define the value of an optimal solution.

Boundary conditions: for k = 0, a path from vertex i to j with no intermediate vertex numbered higher than 0 has no intermediate vertices at all, **hence d (0)= wij**

Recursive formulation:

$$d\frac{(k)}{ij} = \begin{Bmatrix} wij \\ \min(d\frac{(k-1)}{ij}, d\frac{(k-1)}{ik} + d\frac{(k-1)}{kj}) if k \geq 1 \end{Bmatrix}$$

$$\frac{D^{(n)} = (d^{(n)}ij\ )}{d^{(n)}ij\ = \sigma(i,j).}$$ **is the solution for this APSP problem:**

The Floyd-Warshall algorithm: Step (iii)

Compute the shortest-path weights bottom up

FLOYD-WARSHALL(W, n)

{

$\mathbf{D}^{(0)} = W;$

for k ≔ **1 to n**

for i ≔ **1 to n**

for j ≔ **1 to n**

$\mathbf{D}_{ij}^{(k)} := \min(d_{ij}^{(k-1)}, d_{ik}^{(k+1)}, +d_{kj}^{(k-1)},)$

$return\mathbf{D}^{(n)};$

}

$complexity\Theta(n^3).$

Ref: Handouts Page No.161

Give a detailed example for 2d maxima problem
Answer:-
The problem with the brute-force algorithm is that it uses no intelligence in *pruning* out decisions.

For example, once we know that a point pi is dominated by another point pj, we do not need to use pi for eliminating other points. This follows from the fact that dominance relation is *transitive*. If pj dominates pi and pi dominates ph then pj also dominates ph; pi is not needed.
Ref: Handouts Page No.17

How the generic greedy algorithm operates in minimum spanning tree?
Answer:-
A generic greedy algorithm operates by repeatedly adding any safe edge to the current spanning tree. When is an edge safe? Consider the theoretical issues behind determining whether an edge is safe or not.

Let S be a subset of vertices S _ V. A cut (S, V − S) is just a partition of vertices into two disjoint subsets. An edge (u, v) crosses the cut if one endpoint is in S and the other is in V − S. Given a subset of edges A, a cut respects A if no edge in A crosses the cut. It is not hard to see why respecting cuts are important to this problem. If we have computed a partial MST and we wish to know which edges can be added that do not induce a cycle in the current MST, any edge that crosses a respecting cut is a possible candidate.
Ref: Handouts Page No.143

What are two cases for computing

Answer:-
There are two cases for computing Lij the match case if ai = bj , and the mismatch case if ai 6= bj . In the match case, we do the following:

$$L_j^{\,i} = Inserta_j \,\mathrm{int}\, oL_j^{\,i-1},$$

and in the mismatch case, we do the following:

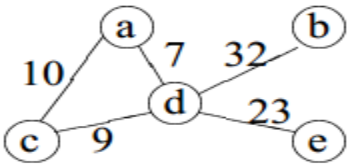
$$L_j^{\,i} = merge(L_{j-1}^{\,i}, L_j^{\,i-1}).$$

Ref: Handouts Page No.143

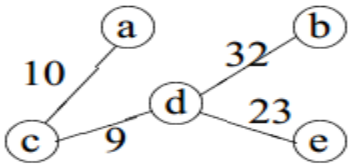
Describe Minimum Spanning Trees Problem with examples.
Problem
Given a connected weighted undirected graph, design an algorithm that outputs a minimum spanning tree (MST) of

Examples

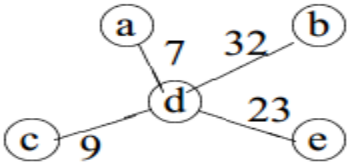
The graph is a complete, undirected graph G = (V, E ,W), where V is the set of pins, E is the set of all possible interconnections between the pairs of pins and w(e) is the length of the wire needed to connect the pair of vertices



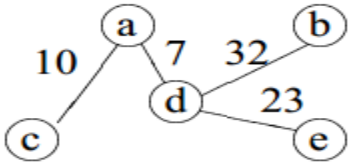
weighted graph



Tree 1. w=74



Tree 2, w=71



Tree 3, w=72

Minimum spanning tree

Ref: Handouts Page No.142

What is decision problem, also explain with example?

A decision problem is a question in some formal system A problem is called a decision problem if its output is a simple “yes” or “no” (or you may this of this as true/false, 0/1, accept/reject.) We will phrase may optimization problems as decision problems.

For example,

the MST decision problem would be: Given a weighted graph G and an integer k, does G have a spanning tree whose weight is at most k?

Ref: Handouts Page No.170

Do you think greedy algorithm gives an optimal solution to the activity scheduling problem?

The greedy algorithm gives an optimal solution to the activity scheduling problem.

Proof:

The proof is by induction on the number of activities. For the basis case, if there are no activities, then the greedy algorithm is trivially optimal. For the induction step, let us assume that the greedy algorithm is optimal on any set of activities of size strictly smaller than |S| and we prove the result for S. Let S0 be the set of activities that do not interfere with activity a1, That is

$$S' = \{ai \in S \mid si \geq f1\}$$

Any solution for S0 can be made into a solution for S by simply adding activity a1, and vice versa. Activity a1 is in the optimal schedule (by the above previous claim). It follows that to produce an optimal schedule for the overall problem, we should first schedule a1 and then append the optimal schedule for S0. But by induction (since |S0| < |S|), this exactly what the greedy algorithm does.

Ref: Handouts Page No.109

Define Forward edge

The most natural result of a depth first search of a graph (if it is considered as a function rather than procedure) is a spanning tree of the vertices reached during the search. Based on this spanning tree, the edges of the original graph can be divided into three classes: forward edges (or "discovery edges"), which point from a node of the tree to one of its descendants,

Ref: Handouts Page No.129 130

Is there any relationship between number of back edges and number of cycles in DFS?

Answer:

The time stamps given by DFS allow us to determine a number of things about a graph or digraph. we can determine whether the graph contains any cycles.

Lemma: Given a digraph G = (V, E), consider any DFS forest of G and consider any edge (u, v) 2 E. If this edge is a tree, forward or cross edge, then f[u] > f[v]. If this edge is a back edge, then f[u] _ f[v].

Proof: For the non-tree forward and back edges the proof follows directly from the parenthesis lemma. For example, for a forward edge (u, v), v is a descendent of u and so v's start-finish interval is contained within u's implying that v has an earlier finish time. For a cross edge (u, v) we know that the two time intervals are disjoint. When we were processing u, v was not white (otherwise (u, v) would be a tree edge), implying that v was started before u. Because the intervals are disjoint, v must have also finished before u.

Ref: Handouts Page No.130

What is the common problem in communications networks and circuit designing?

Answer:

A common problem is communications networks and circuit design is that of connecting together a set of nodes by a network of total minimum length. The length is the sum of lengths of connecting wires.

Consider, for example, laying cable in a city for cable t.v.

Ref: Handouts Page No.142

Explain the following two basic cases according to Floyd-Warshall Algorithm,

1. Don t go through vertex k at all.
2. Do go through vertex k.

Answer:-

Don't go through k at all

Then the shortest path from i to j uses only intermediate vertices {1, 2, . . . , k − 1}. Hence the length of
the shortest is $d_{ij}^{(k-1)}$

Do go through k

First observe that a shortest path does not go through the same vertex twice, so we can assume that we
pass through k exactly once. That is, we go from i to k and then from k to j. In order for the overall path to be as short as possible, we should take the shortest path from i to k and the shortest path from k to j.

Since each of these paths uses intermediate vertices {1, 2, . . . , k − 1}, the length of the path is

$$d_{ik}^{(k-1)} + d_{kj}^{(k-1)}$$

Ref: Handouts Page No.162

Show the result of time stamped DFS algorithm on the following graph. Take node A as a starting node.

Answer:-

Depth-first search (DFS) :

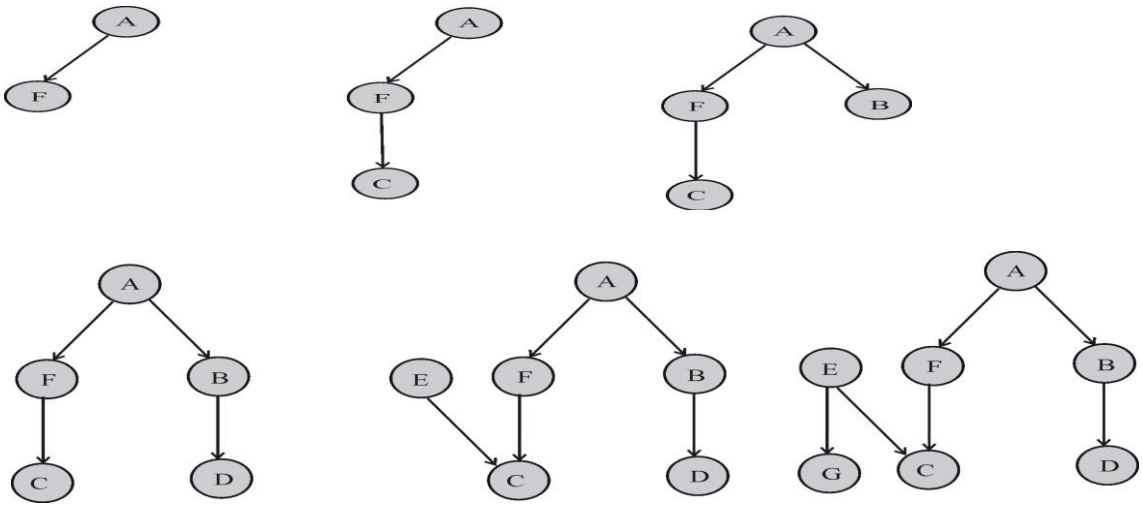
It is an algorithm for traversing or searching a tree, tree structure, or graph. Intuitively, one starts at the root (selecting some node as the root in the graph case) and explores as far as possible along each branch before backtracking.

Formally, DFS is an uninformed search that progresses by expanding the first child node of the search tree that appears and thus going deeper and deeper until a goal node is found, or until it hits a node that has no children. Then the search backtracks, returning to the most recent node it hadn't finished exploring. In a non-recursive implementation, all freshly expanded nodes are added to a LIFO stack for exploration.

```
 DFS (graph)
{
  list L =empty
  tree T =empty
 choose a starting vertex x
 search(x)
  while(Lis not empty)
 {
    remove edge (v, w) from beginning of L
      if w not yetvisited
```

```
    {
      add (v, w) to T
      search(w)
    }
  }
}

search(vertex v)
{
  visit v
  for each edge (v, w)
  add edge (v, w) to the beginning of L
}
```



Ref: http://www.chegg.com/homework-help/questions-and-answers/result-time-stamped-dfs-algorithm-followinggraph-node-starting-node-stronglyconnected-comp-q96642

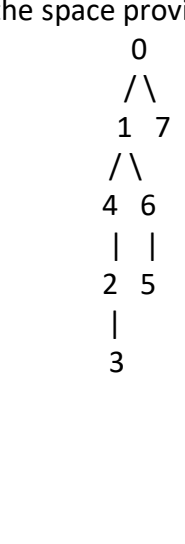
Why we need reduction?
Answer:-
The class NP-complete (NPC) problems consists of a set of decision problems (a subset of class NP) that no one knows how to solve efficiently. But if there were a polynomial solution for even a single NP-complete problem, then ever problem in NPC will be solvable in polynomial time. For this, we need the concept of reductions.
Ref: Handouts Page No.173

Consider the digraph on eight nodes, labeled 1 through 8, with eleven directed edges 1 2, 1 4, 2 4, 3 2, 4 5, 5 3 ,5 6, 7 8, 7 1, 2 7,8 7
Answer:-

0-7 0-1 1-4 1-6 2-3 3-4 4-2 5-2 6-0 6-3 6-5 7-1 7-3

Draw the DFS tree for the standard adjacency-matrix representation. List the edges of each type in the space provided below.

0-7 tree
0-1 tree
1-4 tree
1-6 tree
2-3 tree
3-4 back
4-2 tree
5-2 cross
6-0 back
6-3 cross
6-5 tree
7-1 cross
7-3 cross



Ref
http://www.cs.princeton.edu/courses/archive/fall04/cos226/exams/fin-s01-sol.html

Prove that the generic TRAVERSE (S) marks every vertex in any connected graph exactly once and the set of edges (v, parent (v)) with parent (v) ¹F form a spanning tree of the graph

Answer:-

Generic Traverse

- Suppose we want to visit every node in a connected graph (represented either explicitly or implicitly)
- The simplest way to do this is an algorithm called depth-first search
- We can write this algorithm recursively or iteratively - it's the same both ways, the iterative version just makes the stack explicit
- Both versions of the algorithm are initially passed a source vertex v

Lemma

Traverse(s) marks each vertex in a connected graph exactly once, and the set of edges (v, parent(v)), with parent(v) not nil, form a spanning tree of the graph.

Proof

- Call an edge (v, parent(v)) with parent(v) =6 nil a parent edge.
- Note that since every node is marked, every node has a parent edge except for s.
- It now remains to be shown that the parent edges form a spanning tree of the graph

Ref http://www.cs.unm.edu/~saia/362-s08/lec/lec18-2x2.pdf

What is a run time analysis and its two criteria
Answer:-
The main purpose of our mathematical analysis will be measuring the execution time. The running time of an implementation of the algorithm would depend upon the speed of the computer, programming language, optimization by the compiler etc. Two criteria for measuring running time are worst-case time and average-case time.
Worst-case time is the maximum running time over all (legal) inputs of size n. Let I denote an input instance, let |I| denote its length, and let T(I) denote the running time of the algorithm on input I. Then

$$T_{worst}(n) = \max_{|I|=n} T(I)$$

Average-case time is the average running time over all inputs of size n. Let p(I) denote the probability of seeing this input. The average-case time is the weighted sum of running times with weights being the probabilities:

$$T_{avg}(n) = \sum_{|I|=n} p(I)T(I)$$

We will almost always work with worst-case time. Average-case time is more difficult to compute; it is difficult to specify probability distribution on inputs. Worst-case time will specify an upper limit on the running time.
Ref: Handouts Page No.173

Dijkstra algorithm correctness criteria two conditions
Answer:
We will prove the correctness of Dijkstr's algorithm by Induction. We will use the definition that _(s, v)
denotes the minimal distance from s to v.
For the base case
1. S = {s}
2. d(s) = 0, which is _(s, s
Ref: Handouts Page No.158

Compare bellman ford algorithm with dijikstr's algorithm. Also give the time complexity of bellman ford algorithm (3 marks)

Answer:

Dijkstra's single-source shortest path algorithm works if all edges weights are non-negative and there are no negative cost cycles. Bellman-Ford allows negative weights edges and no negative cost cycles. The algorithm is slower than Dijkstra's, running in _(VE) time. Like Dijkstra's algorithm, Bellman-Ford is based on performing repeated relaxations. Bellman-Ford applies relaxation to every edge of the graph and repeats this V − 1 times.

Ref: Handouts Page No.159

psedo code of timestamp DFS

Answer:

```
DFS(G)
1 for (each u 2 V)
2 do color[u]   white
3 pred[u]   nil
4 time   0
5 for each u 2 V
6 do if (color[u] = white)
7 then DFSVISIT(u)
```

Ref: Handouts Page No.126

variants of shortest path solution

Answer

There are a few variants of the shortest path problem.

Single-source shortest-path problem: Find shortest paths from a given (single) source vertex s 2 V to every other vertex v 2 V in the graph G.

Single-destination shortest-paths problem: Find a shortest path to a given destination vertex t from each vertex v. We can reduce the this problem to a single-source problem by reversing the direction of each edge in the graph.

Single-pair shortest-path problem: Find a shortest path from u to v for given vertices u and v. If we solve the single-source problem with source vertex u, we solve this problem also. No algorithms for this problem are known to run asymptotically faster than the best single-source algorithms in the worst case.

All-pairs shortest-paths problem: Find a shortest path from u to v for every pair of vertices u and v. Although this problem can be solved by running a single-source algorithm once from each vertex, it can usually be solved faster.

Ref: Handouts Page No.153

Prove the following lemma,
Lemma: Given a digraph G = (V, E), consider any DFS forest of G and consider any edge (u, v) ∈E. If this edge is a tree, forward or cross edge, then f[u] > f[v]. If this edge is a back edge, then f[u] ≤ f[v]

Answer:-
Proof: For the non-tree forward and back edges the proof follows directly from the parenthesis lemma. For example, for a forward edge (u, v), v is a descendent of u and so v's start-finish interval is contained within u's implying that v has an earlier finish time. For a cross edge (u, v) we know that the two time intervals are disjoint. When we were processing u, v was not white (otherwise (u, v) would be a tree edge), implying that v was started before u. Because the intervals are disjoint, v must have also finished before u.

RAM(Random Access memory)and its Applications?
Answer:
A RAM is an idealized machine with an infinitely large random-access memory. Instructions are executed one-by-one (there is no parallelism). Each instruction involves performing some basic operation on two values in the machines memory. Basic operations include things like assigning a value to a variable, computing any basic arithmetic operation (+, - , × , integer division) on integer values of any size, performing any comparison (e.g. x _
Ref: Handouts Page No.10

Describe Dijkstra's algorithm working?
Answer
Dijkstra's algorithm works on a weighted directed graph G = (V, E) in which all edge weights are non-negative, i.e., w(u, v) _ 0 for each edge (u, v) 2 E.
Ref: Handouts Page No.154

Prim algorithm graph?
Answer
Prim's algorithm builds the MST by adding leaves one at a time to the current tree. We start with a root vertex r; it can be any vertex. At any time, the subset of edges A forms a single tree. We look to add a single vertex as a leaf to the tree.
Ref: Handouts Page No.149

write suedo code of relaxing a vertex 5
Answer
RELAX((u, v))
1 if (d[u] + w(u, v) < d[v])
2 then d[v] d[u] + w(u, v)
3 pred[v] = u
Ref: Handouts Page No.155

Define NP completeness

Answer:

The set of NP-complete problems is all problems in the complexity class NP for which it is known that if anyone is solvable in polynomial time, then they all are. Conversely, if anyone is not solvable in polynomial time, then none are.

Definition: A decision problem L is NP-Hard if

L0 _P L for all L0 2 NP.

Definition: L is NP-complete if

1. L 2 NP and
2. L0 _P L for some known NP-complete problem L0.

Ref: Handouts Page No.176

Define DAG

A directed graph that is acyclic is called a directed acyclic graph (DAG).

Ref: Handouts Page No.116

How Kruskal's algorithm works ?

Answer:

Kruskal's algorithm works by adding edges in increasing order of weight (lightest edge first). If the next edge does not induce a cycle among the current set of edges, then it is added to A. If it does, we skip it and consider the next in order. As the algorithm runs, the edges in A induce a forest on the vertices. The trees of this forest are eventually merged until a single tree forms containing all vertices.

Ref: Handouts Page No.147

What are two steps generally involved while developing a dynamic programming algorithm?

Answer:

Dynamic programming is essentially recursion without repetition. Developing a dynamic programming algorithm generally involves two separate steps:

Formulate problem recursively. Write down a formula for the whole problem as a simple combination of answers to smaller sub problems.

Build solution to recurrence from bottom up. Write an algorithm that starts with base cases and works its way up to the final solution.

Ref: Handouts Page No.75

The following adjacency matrix represents a graph that consists of four vertices labeled 0, 1, 2 and 3. The entries in the matrix indicate edge weights.

	0	1	2	3
0	0	1	0	3
1	2	0	4	0
2	0	1	0	1
3	2	0	0	0

Answer

NO. Because number of rows and number of columns are always same.

What is the application of edit distance technique?

Answer

Edit Distance: Applications

There are numerous applications of the Edit Distance algorithm. Here are some examples:

Spelling Correction

If a text contains a word that is not in the dictionary, a 'close' word, i.e. one with a small edit distance, may be suggested as a correction. Most word processing applications, such as Microsoft Word, have spelling checking and correction facility. When Word, for example, finds an incorrectly spelled word, it makes suggestions of possible replacements.

Plagiarism Detection

If someone copies, say, a C program and makes a few changes here and there, for example, change variable names, add a comment of two, the edit distance between the source and copy may be small. The edit distance provides an indication of similarity that might be too close in some situations.

Computational Molecular Biology

Speech Recognition

Algorithms similar to those for the edit-distance problem are used in some speech recognition systems. Find a close match between a new utterance and one in a library of classified utterances.

Ref: Handouts Page No.76