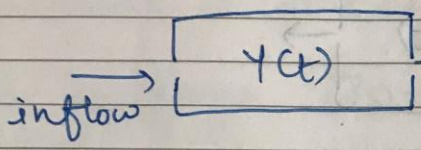
6/1/2020 Modelling & Simulation

Compartment models

→ Systems evolve with time.
→ System as a compartment

Treat system as whole irrespective of inner particles



→ Interested in change of quantity w.r.t time

Rate of change = Rate of inflow − Rate of outflow

Avg. change $\frac{y(x+\Delta x) - y(x)}{\Delta x}$

$\lim_{\Delta x \to 0} \frac{y(x+\Delta x) - y(x)}{\Delta x} = \frac{dy}{dx}$

(i) grow
(ii) decay
(iii) no change

→ In order to model a system by differential equation look if the system can be repres. as compartments.
→ Differential equations are mostly Balance equation. (Eg. $\frac{\partial \rho}{\partial t} = -\nabla \cdot \vec{J}$)

Radioactive Decay
Population of species
pollutants in water bodies
Drug delivery / dosage

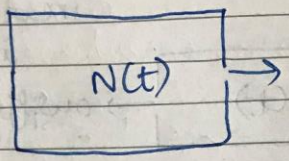
} we can think in terms of compartments

We just consider change with time not space.

* Things are homogenously mixed

(i) No. is large (no. of examples)
(ii) Independent

→ Compartment (Don't look any individually)



→ $N(t+\Delta t) - N(t)$

(i) Diff is negative as loss is happening
(ii) What is loss?

$$\frac{dN}{dt} = -kN$$

Assume: ↓ is linear & $\propto$ # present

$$\therefore N(t+\Delta t) - N(t) = -k\,N(t)$$

(for 1 time unit)

$$\therefore N(t+\Delta t) - N(t) = -k\,N(t)\,\Delta t$$

(for Δt time unit)

(i) $$N(t+\Delta t) = (1 - k\Delta t)\,N(t)$$

Let $\Delta t = 1$,

$$N(t+1) = (1-k)\,N(t)$$

$$\frac{N(t+1)}{N(t=0)} = (1-k)^t$$

(i) $\frac{dN}{dt} = -kN$

$\frac{N(t)}{N(t=0)} = e^{-kt}$

** No model is correct **.

Laplace Transforms $\tilde{f}(s) = \int_0^\infty e^{-st} f(t)\, dt$

$\mathcal{L}\left[\frac{dy}{dt}\right] = \int_0^\infty e^{-st} \frac{dy}{dt}\, dt$

$\frac{d}{dt}(e^{-st} y) = -se^{-st} y + e^{-st} \frac{dy}{dt}$

$\mathcal{L}\left[\frac{dy}{dt}\right] = s\tilde{y} - y(0)$

$\hookrightarrow \mathcal{L}[y]$

$\mathcal{L}\left[\frac{d^2y}{dt^2}\right] = s\,\mathcal{L}\left[\frac{dy}{dt}\right] - y'(0)$

$= s^2\tilde{y} - y(0) - y'(0)$

Eg. $\frac{dy}{dt} = a + by \Rightarrow s\tilde{y} - y(0) = \frac{a}{s} + b\tilde{y}$

$\therefore (s-b)\tilde{y} = y(0) + \frac{a}{s}$

$\therefore \tilde{y} = \frac{y(0)}{s-b} + \frac{a}{s(s-b)}$

Date: / /

$$y(t) = y(0)\, e^{t+bt} + \frac{a}{b}\left[e^{bt} - 1\right]$$

Laplace transformations

(i) Partial fractions
(ii) Poles & residues
(iii) convolution

NLS (9-10)

7/01/2020

Dynamical systems

Maps
Iterative maps
$x_{n+1} = f(x_n)$
(Time: Discrete)

Differential ✓ equations
$x' = f(x)$
(Time: Continuous)
No space dependen

Differential equations:

→ Dimension: order of derivative

$$m\frac{d^2x}{dt^2} + b\frac{dx}{dt} + kx = 0$$

$$\frac{dx}{dt} = v$$

$$\frac{dv}{dt} = -\frac{b}{m}v - \frac{k}{m}x$$

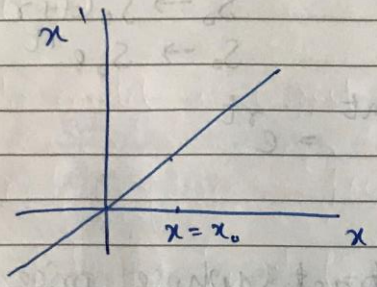
} Though 'y' not present but two dimensio

→ Explicit dependence on time: Consider time as a s var. Dimension ↑

→ $x' = \alpha x$

. $\frac{dx}{dt} = \alpha x$

Given α & x_0 determine $x(t)$.



$f(x) > 0$

$\frac{dx}{dt} > 0$

$\alpha = 1$

$x \uparrow$

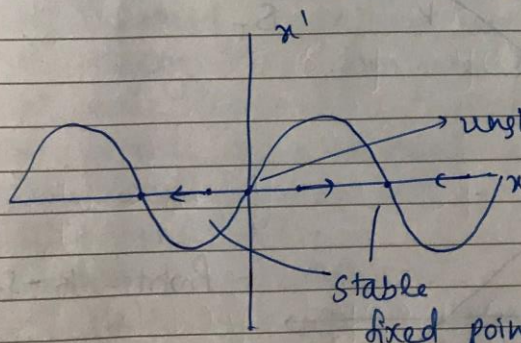
$f(x) = 0$ $(x' = 0)$ → do not move

↳ fixed points ⟨ stable (any change results to fixed point)

unstable (any change results to divergence from fixed point)

① $\frac{dx}{dt} = x' = \sin x$

$t = \ln\left(\frac{\operatorname{cosec} x_0 + \cot x_0}{\operatorname{cosec} x + \cot x}\right)$



Required : "Graph of various functions"

Comp Finance (10-11)

Risky asset

- Equity (stock)
- Commodities
- Currency

Riskfree

- Bank

$S_0 \to S_0(1+r)$

$S_0 \to S_0 e^{rt}$

$$\lim_{n\to\infty}\left(1+\frac{r}{n}\right)^{nt} = e^{rt}$$

Derivative : is a contract whose price depen on an underlying risky asset.

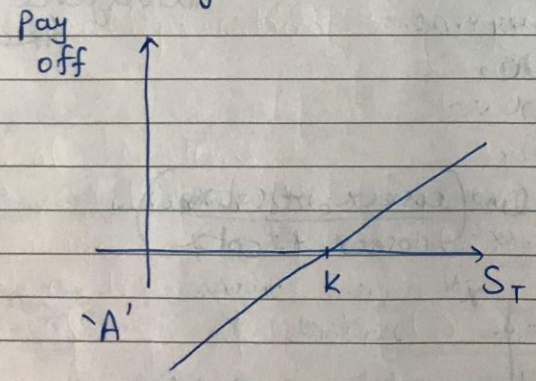
Eg- Forward contract

A — B

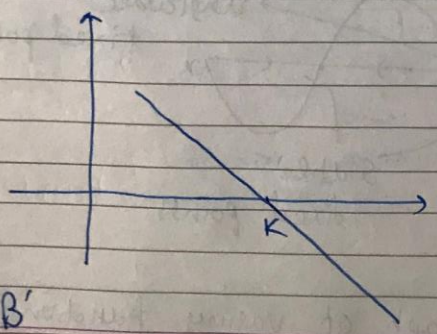
buys sells

K - strike price

t - maturity da



Profit = $S_T - K$



Profit = $K - S_T$

- Hedging & Speculation
- Arbitrage (Risk-free profit)

HM

- Stock options
- Ambience
- Salary
- allowances
- work-life balance
- lot of fields that one can switch

15 points in good organization

(i) Competant Boss
(ii) Friendly supervisor
(iii) Good salary
(iv) Interesting work
(v) Job security
(vi) Chance to learn & keep growing
(vii) Pleasant working conditions
(viii) Recognition for good work
(ix) Fair personal policies
(x) Good advancement in prospects
(xi) Friendly coworkers
(xii) Responsibility
(xiii) Chance to achieve
(xiv) Help each other, rewards
(xv) Participation & decision making

OS (12-1)

exec() - returns only when failure

fork() - fails then returns 'once'
returns twice if call is successful

Threads → Different local variables

HCP (3-4)

Goal: Achieve max possible performance from a computing system for a particular problem.

- Real system
- Theoretical system

Matrix multiplication → complexity (Deterministic)
↳ $O(n^3)$

Real systems
- Non-deterministic system
  - Because of hardware or software
- Non-terminating
- Real (opp. of abstract)

Theoretical systems
- Deterministic system
- Terminating
- Abstract

Let's HPC

System's perspective
- Hardware or Architecture
- Algorithm
- Software environment

Analysis

- input
- methodology of measurement
- software environment
- Run-time environment

Power wall + Memory wall + ILP wall
↳ Instruction level Parallelism

Parallelism
- level 1 → ILP
- level 2 → Thread LP (shared system)
- level 3 → Node LP (Distributed system)

→ Data access is limited so ↑ freq. will not help until data access is improved in speed.

Two points for parallel programming:

(i) Hardware is parallel (we can't get a single transistor)

(ii) Real time application [accurate
                           [time constraint

8/01/2020

DELUXE Page No.: Date: / /

HM

→ OB is study of the application of knowledge about human behaviour in an organization.

→ Organization is the study of structure & functioning and performance of an organization as individual, as a group and the individual & group in the organization.

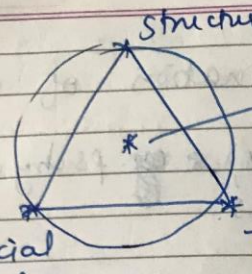
→ OB is defined (individuals (people's)) as optimum utilization of human resources for attainment of organizational goals by relating the knowledge about human nature and behaviours.

→ OB studies human relations treating people with respect and dignity and how people act and react in an organization.

→ OB is studied under two levels:

(i) Individual (Job satisfactions, motivation, empowerment, ethics, values, attitude)

(ii) Group (working with other people (team) team work, group dynamics & at organizational level it sees the challenges the organization takes to improve customer satisfaction, service, sees to change in technology, innovation & resistance to change.



→ for organization.

→ Earlier managers were field specific. (BTech + MBA)
→ Now, mangers are people-oriented, try to increase productivity of people.

(i) Responsibility
(ii) Commitment
(iii) Growth
(iv) Money

} Earlier people continued in same organization.

→ Social system: Diff. kind of people, culture, the diversity that is brought into the system, diff levels of education & knowledge, the value system individuals have, customs, traditions, all these are responsible in an organization to make a social system.

→ Technology: How people respond to changes, to new technology, how much of resistance is there in organization, how managers deal with these resistance to change.

→ Behaviour is combination of ologies.

ologies → anthropology, psychology, sociology, economics.

→ Manager is a person who makes the work done efficiently.

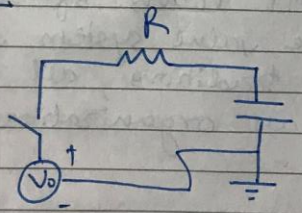
→ management is doing the work efficiently using all the given or efficient resources.

→ Organization means when two or more people come togethes under one roof in the system to achieve the desired goal.

→ Technical skills, human skills, Conceptual skills,

11-12 (NLD)

(1)

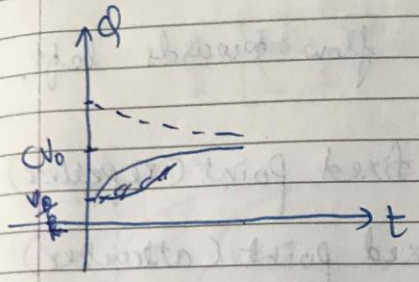


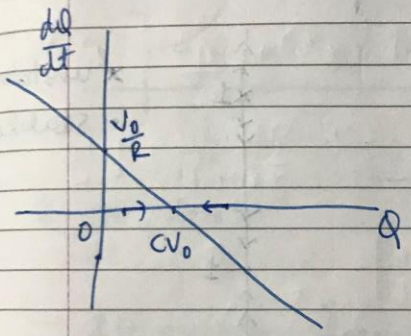
$$-V_0 + IR + \frac{Q}{C} = 0$$

$$-V_0 + \frac{dq}{dt} R + \frac{q}{C} = 0$$

(2)

$$\frac{dQ}{dt} = \frac{V_0}{R} - \frac{Q}{RC}$$



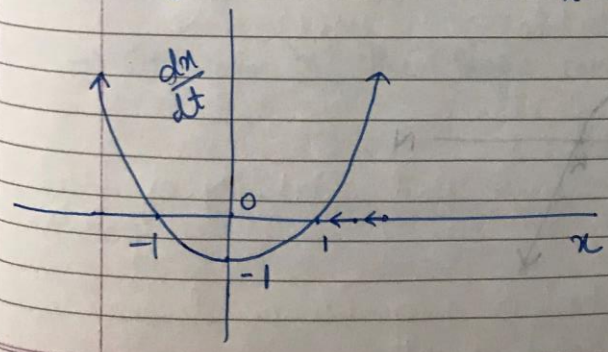


→ For fixed point, $f(Q) = \frac{dQ}{dt} = 0$.

$\therefore Q = CV_0$ (fixed point)

(2) $\frac{dx}{dt} = x^2 - 1$

$x = \pm 1$ (fixed points)

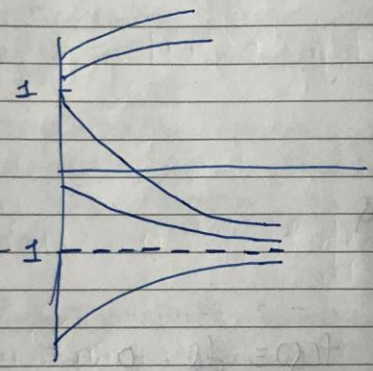


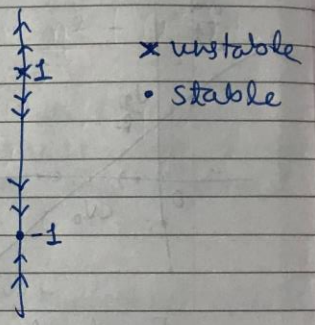
→ If $\frac{dx}{dt} > 0$ then flow towards right.

→ If $\frac{dx}{dt} < 0$ then flow towards left.

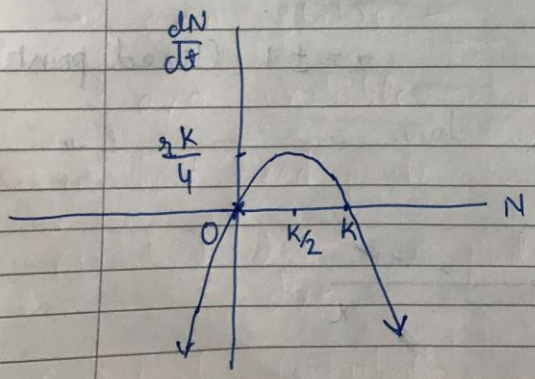
'1' → unstable fixed point (repeller)

'-1' → stable fixed point (attracter)



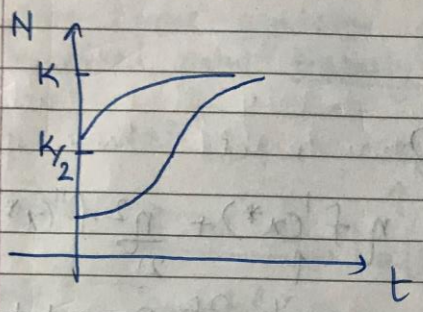


③ $\frac{dN}{dt} = rN(1 - \frac{N}{K})$; $r, K > 0$



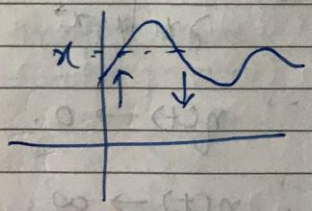
$$\frac{dN}{dt} = -\frac{r}{K}[N^2 - KN]$$

$$= -\frac{r}{K}\left[\left(N - \frac{K}{2}\right)^2 - \frac{K^2}{4}\right]$$



* $\frac{dx}{dt} = f(x)$

→ 1D system does not depending upon 't' explicitly can't show oscillations. (uniqueness cond. violated)



→ Graph not possible.

→ At same 'x', the slope can either ↑ or ↓.

$x = x^*$ → fixed point

→ Perturbations from fixed points:

$$x' = f(x)$$

$$x = x^* + \eta$$

$$x' = f(x^* + \eta)$$

$$= f(x^*) + \eta f'(x^*) + \frac{\eta^2}{2!} f''(x^*) + \dots$$

↑ write $\frac{\partial f}{\partial x}$ for safety.

$f(x^*) = 0$ ∵ $\left.\frac{dx}{dt}\right|_{x=x^*} = 0$.

$$\eta' \approx a\eta \qquad a = \left.\frac{\partial f}{\partial x}\right|_{x=x^*}$$

$$\eta(t) = \eta_0 e^{at}$$

→ $a < 0$ stable → ∵ $\eta(t) \to 0$.

$a > 0$ unstable → ∵ $\eta(t) \to \infty$

Method II:

(i) Find fixed points

(ii) Find $\frac{d^2 f}{dx^2}$ and find stability of fixed points.

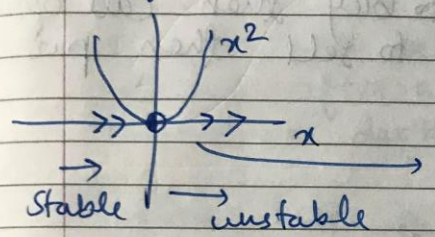
(iii) Find perturbations grows or decays towards fixed point.

→ we just can find stable & unstable fixed points.

Method II: Known as linearization. (we can't tell about trajectory)

If $\frac{\partial f}{\partial x} = 0$ then going to higher terms will make the problem non-linear.

→ "Non-linear systems grow away or converges to fixed point linearly."



Not in 'x^3'

→ half stable fixed point.

$\frac{dx}{dt} = ax$ [change in parameter 'a', the stability changes and the graph changes drastically]

↳ Bifurcation
↳ (Phase transition)

(12-1) Comp. Finance

$F_0 = S_0 e^{rT}$

F_0 ↓ Forward price
S_0 ↓ Spot price
~~Strike price~~

if $F > Se^{rT}$ or $F < Se^{rT}$ and earn profit.
So, $F = Se^{rT}$ only.

$r \rightarrow$ risk free interest rate
$T \rightarrow$ time remaining to mature.

$F_0 = S_0(1+r)$

A —option price→ B

option holder / buyer — Right, but no obligation.

option writer / seller — obligation

If A has option to buy then call option & if A has option to sell then put option.

(3-4) HPC

ILP (Instruction level parallelism) Pipeline

Complex Process → Divide sub tasks

→ n (no. of instruction)

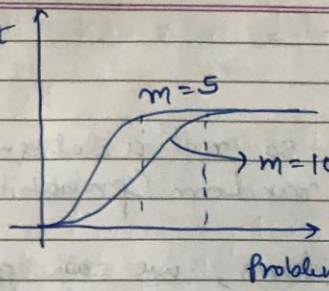
↓ m depth of pipeline

$$\text{Speedup} = \frac{nm \text{ (without pipeline)}}{n+m-1 \text{ (with pipeline)}}$$

$$= \frac{m}{\frac{m}{N} - \frac{1}{N} + 1}$$

if $N >> m$

$$\therefore \text{speedup} = \frac{m}{1} \quad (\text{Not if } m \leq n)$$



Depth ↑ then better performance can be obtained after a certain time. (more time than ↓er depth).

→ Pipeline helps in dividing complex tasks into smaller tasks (helping in concurrency) and its speed is directly prop. to depth of pipeline.

$$\text{Throughput} = \frac{\text{Total no. of operations}}{\text{Total time}}$$

$$= \frac{\text{Flops}}{s}$$

Node performance in GFlops = (CPU speed (GHz)) × (no. of CPU cores) × (CPU inst. per cycle) × (no. of CPUs per node)

$$\text{Performance} = \frac{\text{cycles}}{\text{sec}} \times \frac{\text{Flops}}{\text{cycles}} \times \text{No. of cores.}$$

↑ 2.5

↳ $\frac{\text{Flops}}{\text{cycles}} = 4$ (typically)

↳ 4 nodes with 16 cores each.

9/01/2020 M & S (9-10)

Radioactive Decay

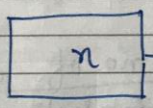
→ No clock attached, so not a deterministic system so go for random (probability) system.

→ For large no. of atoms, we can go for differential eqⁿ's as average can be taken.

(i) Number is large

→ large is large enough that any statistical variations are insignificant.

(ii) Independent



$\frac{dn}{dt} = -kn$ (first take only 'k', then if it doesn't match with results then use '-kn')

-ve because only outflow.

→ Why not probabilistic model & why deterministic model?

$n(t) = n_0 e^{-kt}$

$\frac{n(t)}{n_0} = e^{-kt}$ (Prob. of no. of atoms present)

$1 - \frac{n(t)}{n_0} = 1 - e^{-kt}$ (Prob. of no. of atoms decay)

$$F(t) = \frac{1 - n(t)}{n_0} = 1 - e^{-kt}$$

$$f(t) = \frac{dF}{dt} = ke^{-kt}$$

Expectation = $\int_0^\infty t f(t)\, dt = k \int_0^\infty t e^{-kt} dt$

of time taken to move out of compartment.

$$k\left[-\int_0^\infty \frac{d}{dk} e^{-kt} dt \right]$$

$$= -k \frac{d}{dk} \int_0^\infty e^{-kt} dt$$

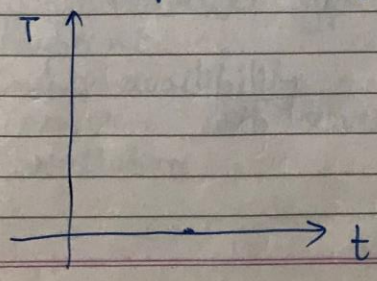
$$= -k \frac{d}{dk} \left[\frac{e^{-kt}}{k} \right]_\infty^0$$

$$= -k \left(-\frac{1}{k^2} \right) = \frac{k}{k^2} = \frac{1}{k}$$

Cup of Coffee problem:

T_E : Environment temperature

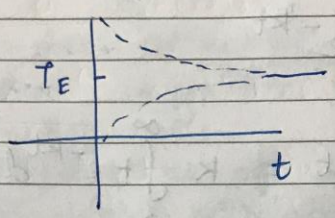
T : Temperature of coffee



(i) Treat as compartment

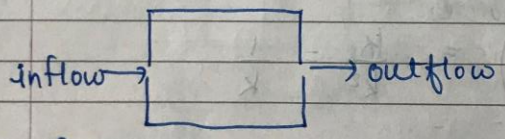
(ii) $\frac{dT}{dt}$

$\frac{dT}{dt} \propto (T - T_E)$ (Is sign + or - relevant here?)



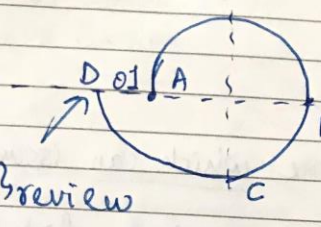
→ When gain = loss then in most linear systems modeled by balance equation then $\frac{dT}{dt} \to 0$

→ In divergent systems like $\frac{dT}{dt} = kT$, $\frac{dT}{dt} \to \infty$. No equilibrium is achieved.



① Lake Pollution
② Drug Dosage

(p-11) Software Eng.



risks, alternatives, resolve

AC → single prototype.

D. review

CD → plan for next objectives

AB → risk analysis

→ After all objectives, when we have operational prototype we start using main 5 types to build product.

Two imp points

(i) Order of activities
(ii) Transition between them.

Functionalities of Ticket Distributer system:

- Issue Ticket
  - Single or multiple
  - Day (date)
  - Price (Total price also)
  - Traveller type

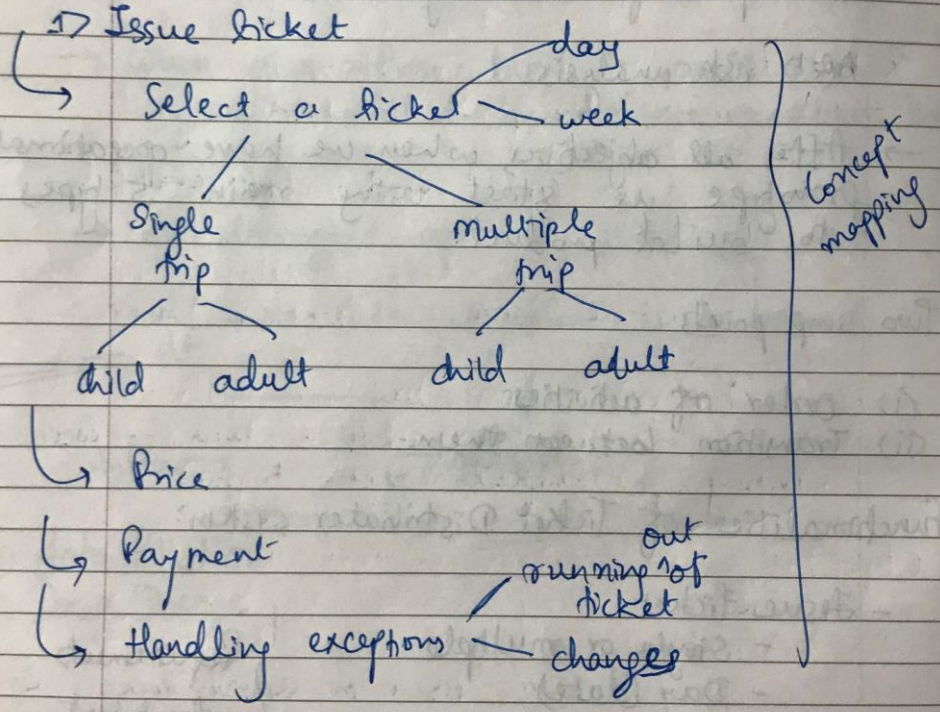
  } Requirements for ticket

- Payment
- Count availibility
- Connection with server
- Cancellation

User story

As a traveller,

I need a machine which can issue ticket such that I can purchase ticket.

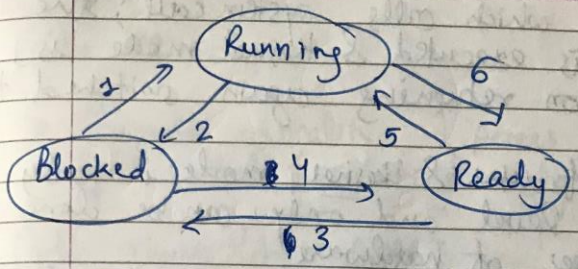


→ These requirements are not independent.

① Requirement Engineering

② Concept Mapping.

OS (2-1)



(a) Transition 3 : Ready to Blocked

→ Not legal
→ Only running processes are blocked.
→ Blocked state is meant for stopping a running process to wait for an event.

(b) Transition 1 : Blocked to Running

→ from Blocked state a process goes to ready state first.
→ So, it is not legal.
→ Because some other process would be already running so scheduler needs to decide which process to run from ready state.

System call

→ There are some resources in system which are shared by processes like memory, CPU etc.
→ We don't want to have a process an uncontrolled access to hard drive or processor.
→ System calls allow a process to allow a resource to restricted use of it.
→ At hardware level : (i) User mode (ii) Kernel mode
→ Certain instructions can only be executed if CPU is in Kernel mode. (For accessing certain resources).

→ The instructions which calls system call; the system call is executed & Kernel mode is entered & on returning again switched to user mode.
→ This checking of user & kernel mode is only at hardware level and only can be done with the use of hardware.
→ System call is the only way to switch from user mode to kernel mode.
→ In kernel mode, OS routines are called & they cannot be tempered.

Assembly instruction { trap, return-from-trap

→ System calls → Kernel stack
normal funcs → user stack.

* How functions work at machine levels?
Book - Briant & Halloren
Computer system: Programmers perspective.

→ A timer is kept in hardware (Timer Interupt).
So, on timer being completed control is regained by OS and again it is decided who to give the control of hardware.

Scheduling decision made
(i) System call invoked by process
(ii) Timer interrupt happens.

MLFQ → successfull scheduling approach.

* xV6 → An OS

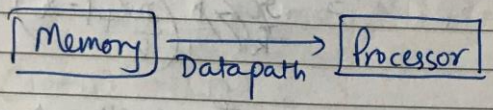
(3-4) HCP

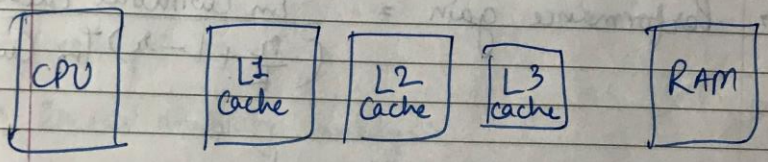
Cache / Memory

* Temporal locality
* Spatial locality

} Access pattern of algorithm

Cache reuse & hit (Diff.)





→ Cache is 'k' times faster than RAM.

→ 'r' is the reuse ratio.

RAM → Bandwidth, Latency Processor → Frequency

→ Cache has better bandwidth & latency than RAM.

→ r is fraction of load/store that can be satisfied from cache.

Access time to main memory (T_m)

Access time to cache (one level) (T_c)

$$T_c = \frac{T_m}{K}$$

→ Average access time = $\frac{r}{\text{hit}} T_c + T_m(1-r)$

$= r\frac{T_m}{k} + T_m - rT_m$

$= \frac{r}{k}T_m + T_m - rT_m$

$= \left(\frac{r}{k} + 1 - r\right) T_m$

→ Performance gain = $\frac{T_m \text{ (without cache)}}{\left(\frac{r}{k} + 1 - r\right) T_m \text{ (with cache)}}$

$= \frac{1}{\left(\frac{r}{k} + 1 - r\right)}$

$= \frac{k}{r + (1-r)k}$

→ $r = 0$

P.G = 1

→ $r = 1$

P.G = k

Cache line C For Spatial locality & hit)

→ To increase the cache hit ($d_c = 16$)

Hit ratio = 15/16

Von Neuman bottleneck

→ The rate of computation is increasing but data access rate is not being able to cope up. This diff is Von Neumann bottleneck.

Also called → Memory wall / DRAM gap

10/01/2022

(10-11) NLD.

→ fixed points

→ linear stability analysis.

$\left.\frac{\partial f}{\partial x}\right|_{x=x^*}$ >0 unstable
<0 stable

Eg - $x' = 1 - x^2 = f(x)$

$f'(x) = -2x$

$x^* = \pm 1$

$f'(1) = -2$ (stable)
$f'(-1) = 2$ (unstable)

Newton's eq^n → $mx'' = -\frac{\partial V}{\partial x} = f(x)$

Pendulum → $mx'' + m\gamma x' + m\omega^2 x = 0$
(i) Overdamped → No influence of 2nd order term.
(ii) Underdamped
(iii) Critically damped

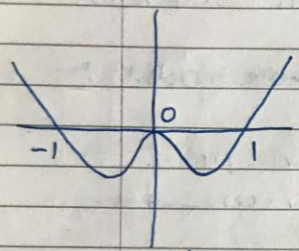
Eg- $x' = x - x^3 = f(x)$

$x^* = \pm 1, 0$

$-1, 1 \rightarrow$ stable

$0 \rightarrow$ unstable

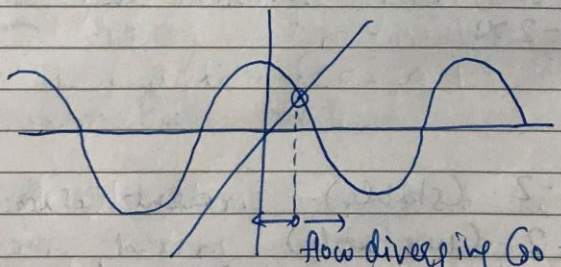
$V = -\int f(x)\,dx = -\frac{x^2}{2} + \frac{x^4}{4} + C$



Eg- $x' = x - \cos x = f(x)$

For fixed points, $f(x) = 0$

$\therefore x = \cos x$

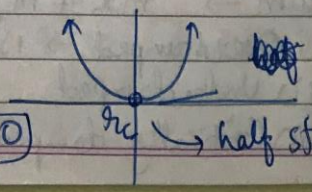


flow diverging (so unstable fixed points)

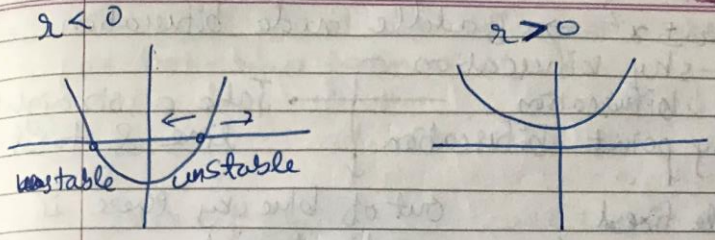
→ Solution using numerical methods like bisection, newton-raphson etc.

Eg- $x' = r + x^2$

if $r = 0$



Bifurcation point $r = \boxed{r_c = 0}$ r_c → half stable



→ For $r > 0$ the system is just diverging, on ↓ r (coming close to zero) then it becomes a half stable fixed points.

→ On ↓ or further, the half stable point is divided into two fixed points i.e. one stable & one unstable fixed point.

→ There can never be two adjacent stable or unstable fixed points.

→ On changing the value of constant, the behaviour of the system also changes drastically.

→ Any physical system showing such property is called "Bifurcation"
↳ only by non-linear not by linear systems.

→ Something which wasn't present, suddenly appears or something was present, suddenly disappears. → (water to ice) (suddenly)

→ In large systems, self-organization takes place; called phase transition, same as bifurcation.

→ $x' = r \pm x^2$ → Saddle node bifurcation (→ does no fixed point can be reduced to this form called "normal form")

→ blue-sky bifurcation
→ fold bifurcation
→ turning point bifurcation.

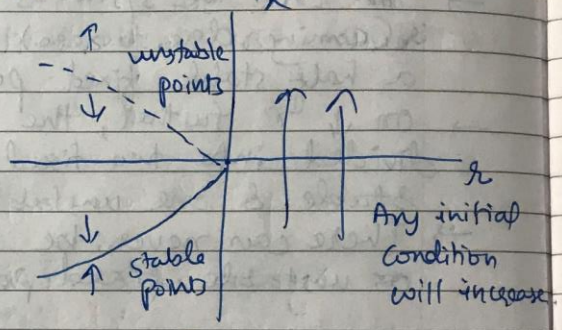
→ Take a straight line & fold

↳ a stable fixed point turns around & becomes unstable

↳ out of blue sky there is a fixed point.

$x' = r + x^2$

$x^* = \pm\sqrt{-r}$



(↑ or ↓ show how system changes)

Objective: Given an initial condition, we want to know what happens to sol^n.

Here x_0 & r is given, what happens to sol^n.

$x(t) = f(x_0, r, t)$] Not trajectory but dynamics.

Types of Bifurcation:

(i) Saddle node → [sudden appearance or sudden disappearance of fixed points in pair ↑ not single]
(ii) Pitchfork
(iii) Transcritical ↳ (along the line change their stability)

↳ Two new stable fixed points appear.

→ In Non-linear partial diff. eq^n's, still research going on for normal form.

(11-12) HM

(i) Technical Skills
(ii) Human skills
(iii) Conceptual skills
↳ Imp for higher posts like decision making, problem solving, critical thinking.

- Group & Group Dynamics.
  → How team together works & achieves goal. working on a particular project.
- Leadership
  → Influence on other people & translate the vision into reality.
- Motivation
  → Influencing people i.e. pushing button at right time.
  → Give rewards, awards, appreciation in intrinsic or extrinsic way.
- Industrial Relation
  → Relation between manager & management.
  → Relation bet^n employer & employee.
  → If industrial relation is good then the lockouts, strike, grievances will be lesser in organization.

- Conflict Management.

→ Difference of opinion in logical thinking which leads to disturbance in work or politics in the organization.

- change management.

→ In an organization, there is always an option to change but people are in their comfort zone & don't want change.

Z Managers (William Ouchi)

→ Combination of American & Japanese type of working.

→ American companies like IBM, intel, HP, Kodak is combination of Theory Z.

Japanese → They have high productivity & loyal workforce because they believe in lifetime employment to their employees until they retire at the age of 55.

→ They donot fire an employee unless committed a crime.

→ The promotions are slow and are awarded only after they have served the organization for a considerable period of time.

→ Employees are trained in all aspects of the organizational functioning not just a specified area.

→ Japanese organizations take collective decisions & collective responsibility to carry out the work.

→ Employees, customers, suppliers; they have the trust & goodwill (relation bet^n them).
→ They are not only concerned about the performers of the employees but also about the family life and social life.
→ They are the people working, are loyal & committed to the organization. (Don't leave in 6 mon to 1 year)
→ Growth in this company is slow.

American
→ Short term employment.
→ Downsizing is there if the performance is not good.
→ They believe in going fast track ie. award, promotions to people, employees for extraordinary performance.
→ If people are good then they can climb the ladder very fast. & If they are not good they are out.
→ Career path of the employees are specialised in particular area.
→ Well defined rules & policies to regulate the employee behaviours.
→ Focus on individual only, not concerned about family; only concerned about the professional life of the people.

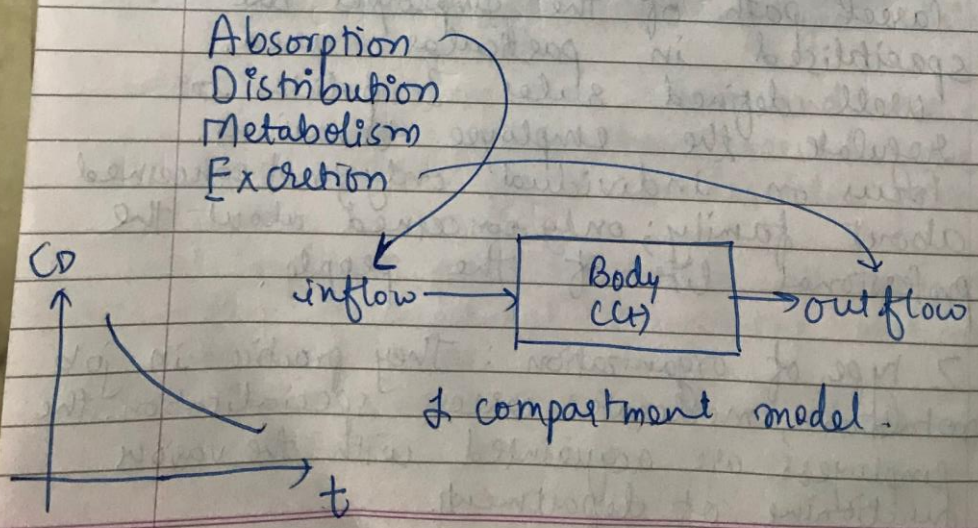
The Z type of organization: They practice in job rotation, moderate career specialisation. The employees are acquainted with the various functioning of department.

→ Process of promotion is slow which ensures people or employees understand the culture, belief, value, culture of the organization before joining or thinking of responsibilities.
→ Decisions are made collectively by managers

The Z type of organization have less of supervision & control.
Such organizations do not have

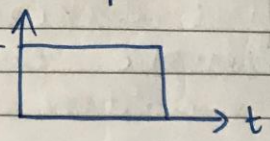
as they offer good working conditions and attractive paybacks.
→ The demerit part is they are not open to diverse views & conflicts occur for personal goals in the organization.
→ People who are culturaly dissimilar may find themselves isolated.

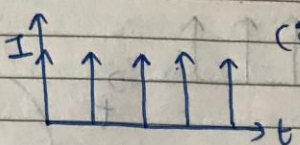
M & S (12-1)

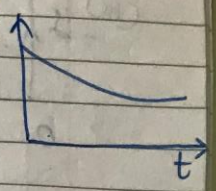


1 compartment model.

Three assumptions:

(i) 

(ii) 

(iii) 

$$\frac{dC}{dt} = I(t) - k(t)\, k\, C(t)$$

↑ ↳ ∵ Concentration ↓ exponentially.

Consider, (i), (ii) & (iii)

$$\Rightarrow s\tilde{C} - C(0) = \tilde{I} - k\tilde{C}$$

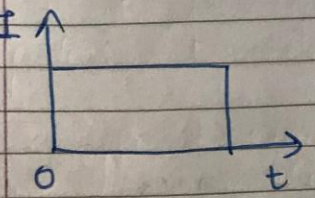
$$(s+k)\tilde{C} = C(0) + \tilde{I}$$

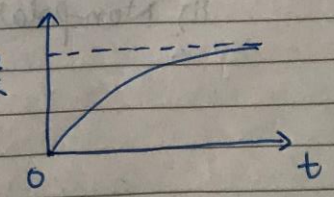
$$\tilde{C} = \frac{C(0)}{s+k} + \frac{\tilde{I}}{s+k}$$

$$\mathcal{L}^{-1}[F(s)G(s)] = (f*g)(t)$$

$$\therefore C(t) = C(0)e^{-kt} + \int_0^t e^{-k(t-t')} I(t')\, dt'$$

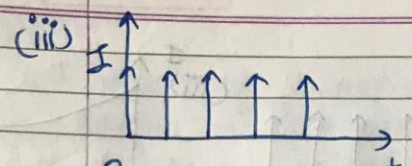
i) $$\Rightarrow C_0 \int_0^t e^{-k(t-t')} \delta(t')\, dt$$

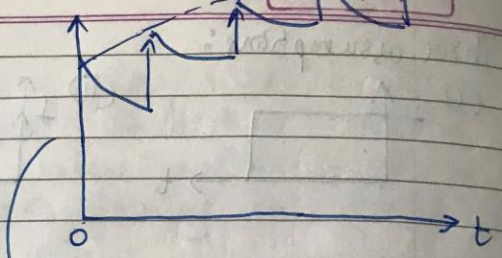
ii) 



$$\frac{C_0}{k}(1 - e^{-kt})$$

(iii)





→ $C(t=T^*) = C_0 e^{-kT} + C_0$

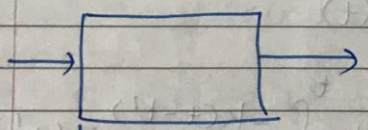
↳ Stabilizes approximately near $\frac{C_0}{k}$.

$$C(t=2T^*) = (C_0 e^{-kT} + C_0)e^{-kT} + C_0$$

$$= C_0[1 + e^{-kT} + e^{-2kT} + \dots]$$

$$C(t=nT^*) = C_0\left(\frac{1-e^{-nkT}}{1-e^{-kT}}\right); C_{max} << C_{min}$$

Eg-



Lake of constant volume V_L

$$\frac{dC}{dt} = 0 - k_1 C_0 - k_2 C$$

↑ polar ↑ non-polar

Pollutants : i) Polar
ii) Non-polar

DELUXE
Page No. :
Date : / /

HCP (3-4)

Flops/sec

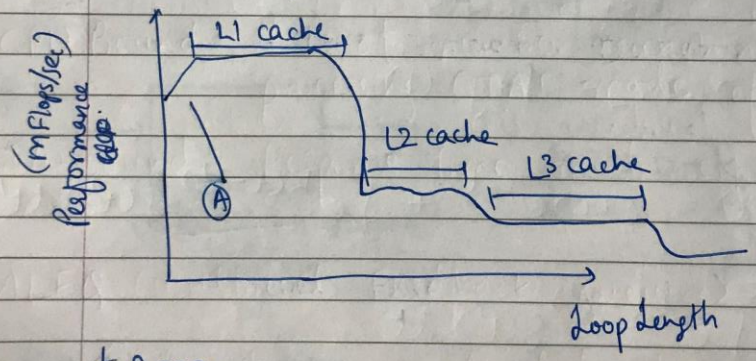
Problem size(N)

Imp : start = clock();
& other time measuring functions.

: Out of order execution.

Throughput = $\frac{N * NITER * 2}{(End\ time - Start\ time)}$ → ∵ (one + & one x)

→ Vector triad
→ compiler optimization.



$ lscpu

(A) → Because as the problem size is smaller, the pipeline is not utilized properly.
→ Pipeline is efficient only for large problem size.
→ No. of arrays also a factor considered.
→ Diff. between malloc & calloc w.r.t place of memory allocation.

Block matrix multiplication & other types of optimal techn. for matrix multiplication.

Balance analysis of loops:

(i) Machine Balance = $\frac{\text{memory bandwidth}}{\text{peak performance}}$ $\frac{\text{Bytes}}{\text{Flops}}$

(ii) Code Balance = $\frac{\text{data traffic}}{\text{Floating pt. ops}}$

↳ also unit: $\frac{\text{Bytes}}{\text{Flops}}$

In slide eg- CB = $\frac{4 \times 8 \text{ (4 doubles)}}{2 \text{ (Becoz 2 ops)}} = 16$

→ CMA (Compute to memory access) = $\frac{\text{Flops}}{\text{Bytes}}$.

↳ In GPU's, this ratio is high.

$$CMA = \frac{1}{CB}.$$

→ Good performance = load some data & lot of operations.

CMA = Computational Intensity

→ Machine Balance cannot be changed. Thus, only changing the architecture we can change MB.

↳ Thus, for same architecture we need to play with Code Balance.

Optimizing a code → Performance modelling

(i) Profiling a code (gprof from GNU)

→ Takes a code & gives locations of compute/mem ratio is low.

~~MLFQ (Q2 → Q1)~~

13/10/20 OS (9-10).

TAT (Turnaround time): Time between i) Job enters ii) Job gets completed.

RT (Response Time): Time between i) Job enters ii) Job scheduled for first time.

CPU Bound: Lots of number crunching & processing CTAT made efficient i.e. ↓

I/O Bound: Response time made efficient i.e. ↓

MLFQ (Multilevel Feedback queuing).

→ Ready Queue is divided into many no. of queues.
→ No. of queue is a metric which is determined on the basis of hit & trial or practicality.
→ No. of queues are fixed. Their priority levels are different.
→ Within the queue RR (Round Robin)

scheduling is used. All queues can have diff. time slices.

→ Scheduler doesn't know if the job is CPU bound or I/O bound

→ Jobs can change their behaviour in the coarse of time.

→ I/O bound jobs does not exhaust time slices completely while CPU bound jobs frequently exhaust time slices.

Rules of MLFQ:

i) If Priority(A) > Priority(B) then A runs & B doesn't.

ii) If Priority(A) = Priority(B), A & B run in Round Robin.

iii) When a job enters a system we don't know anything so I/O bound assumed and placed at highest priority queue.

iv) If entire time slice is used up, priority of job is reduced.

v) If entire time slice is not used, priority of job is kept at same level.

Problems:

(i) Starvation: Too many interactive jobs & so long running jobs will never receive CPU time.

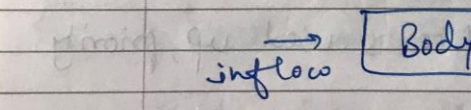
(ii) Game the scheduler: (Assume that processes are not malicious) Doing something to trick the scheduler into giving more than fair share of resources.
Time slice: 10 ms
Then a process will voluntarily give CPU after 9 ms (cheat)

(iii) No mechanism to go up the queue.
(what if CPU bound changes to I/O bound?)

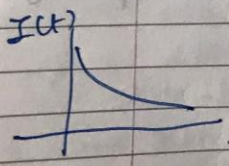
→ Boosting priority → After some fixed time 'S', all jobs are moved to topmost queue.

So, problems (i) & (iii) solved.

(12-1) M&S



$$\frac{dC}{dt} = I(t) - kC$$



$$C(t) = C_0 e^{-kt} + \int e^{-k(t-t')} I(t')\, dt'$$

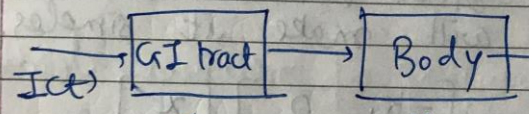
$I(t') = \delta(t)$ → ignore this term.

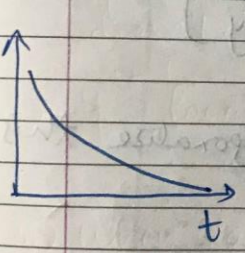
first assumed:

i) Pill taken instantaneously & distributed uniformly instantaneously.

Now, we are breaking the assumption that it is not merged instantaneously.

→ Body is still considered a compartment; just there is a channel GI-tract through which the pill goes to the body.





$$\frac{dx}{dt} = -k_1 x \quad \text{— ①}$$

(I(t) not considered as one dosage s(t) & immediately dissolves.

$$\frac{dy}{dt} = k_1 x - k_2 y \quad \text{— ②}$$

Using Laplace Transform:

$$s\tilde{x} - x(0) = -k_1 \tilde{x}$$

$$\tilde{x} = \frac{x(0)}{s + k_1}$$

$$s\tilde{y} = k_1 \tilde{x} - k_2 \tilde{y} \quad \text{(Initial for } y = 0)$$

$$\therefore \tilde{y} = \frac{k_1}{(s+k_2)(s+k_1)}$$

$$\therefore \tilde{y} = \frac{k_1 x(0)}{k_1 - k_2}\left[\frac{1}{s+k_2} - \frac{1}{s+k_1}\right]$$

$$y = \frac{k_1 x(0)}{k_1 - k_2}\left[e^{-k_2 t} - e^{-k_1 t}\right]$$

→ In this coupled ① & ② eqn's the dependence of one on other variable can be removed that only will make it simples.

$$\frac{d}{dt}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -k_1 & 0 \\ k_1 & -k_2 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix}$$

eigen values & eigen vectors → will diagonalize this matrix.

So, we will get

$$\frac{dx}{dt} \propto f(x)$$

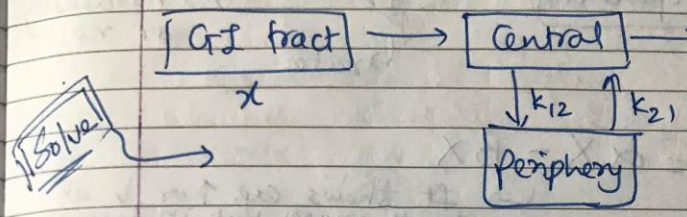
$$\frac{dy}{dt} \propto f(y)$$

→ We can solve that afterwards.

$$\bar{x}(t) = c_1 e^{\lambda_1 t}\bar{v}_1 + c_2 e^{\lambda_2 t}\bar{v}_2$$

→ the decay will be in the direction of eigen vectors and the amt. of decomposition will depend on eigen values.

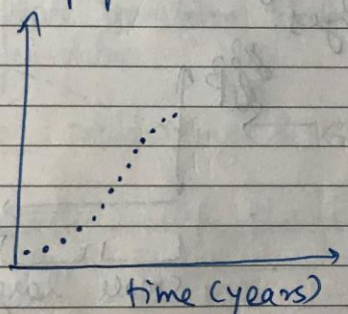
→ Body can be considered as two compartments.



Solve

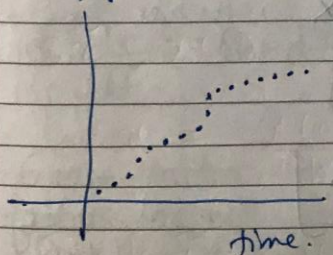
→ For multiple compartment problems write the eq^n's in matrix form and diagonilize the matrix.

Q. World population



How population changes with time? (Main ques.)

Bacteria population



(i) What leads to ↑ or ↓ in population?

↑ → birth

↓ → death.

birth → world population → death

α : rate

β : rate

x : no. density or no.

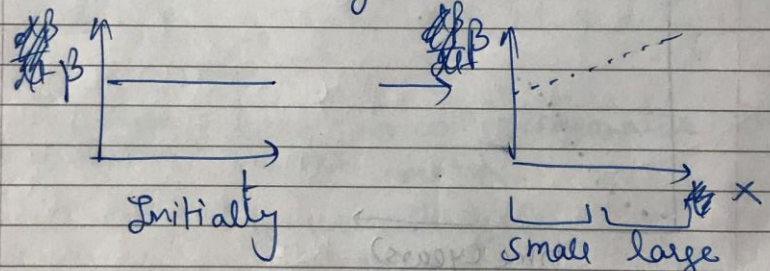
$$\frac{dx}{dt} = \alpha x - \beta x$$

↳ It shows exp. ↑ or ↓ in small ranges but in large ranges it saturates.

→ This won't work ∵ $\alpha > \beta$ then divergence but never like that.

↳ Discovered by Malthusian Explosian.

→ Due to availibility of resource, death rate should be changes.



$$\beta \to (\beta + \gamma x)$$

$$\frac{dx}{dt} = (r - \gamma x)x$$

$$\boxed{r = \alpha - \beta}$$

$$\frac{dx}{dt} = rx\left[1 - \frac{\gamma}{r}x\right]$$

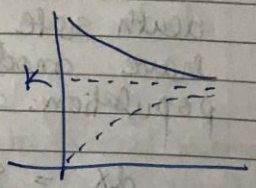
$$K = \frac{r}{\gamma}$$

16/

$$\frac{dx}{dt} = rx\left(1 - \frac{x}{k}\right)$$ → Logistic Equation.

$K < x$ $\quad \frac{dx}{dt} \uparrow$

$K > x$ $\quad \frac{dx}{dt} \downarrow$



→ Constraint imposed by resources which affects the death rate which is directly linearly prop. to 'x' & shows saturation in population.

(i) Laplace Transform } Solution of Diff. equations.
(ii) Eigen-value

16/1/2020 Modelling & Simulation (9-10)

birth — b — [population] — d — death

X

$$\frac{dx}{dt} = (b-d)x$$

↳ $d \to d + \gamma x$

$$\frac{dx}{dt} = (b-d)x - \gamma x^2$$

→ Space factor for yeast and such many factors affect the death rate

→ Birth rate gets affected due to loneliness but we assumed that it doesn't.

→ Also, we assumed all are identical.
→ Due to development in medical science, death rate should decrease but we have modelled death to increase with population.

$$\frac{dx}{dt} = rx\left(1 - \frac{x}{K}\right) \rightarrow K(t)$$

→ K should also be function of time because along the time due to advancements, value of K increases.

(12-1) OS

MLFQ

→ Time allotment used. If time slice is of 30 ms. Once it gives after 20 ms. then after 10 ms of second slice it will be denoted.
* → But system call was made only when the time slice completed so now after end of time allotment, system call is made.

Lower priority queues → Longer time slices (Because mostly long running jobs & time of context switching saved)

Higher priority queues → Small time slices.

Q. How many queues used ?
Q. How long time slice at highest & lowest priority queue ?

File systems

→ File descriptor table stored in Kernel memory.
→ If same file opened twice, they would have diff. file descriptors & diff file table entry.
→ File data entry is removed (on calling close) only if any file descriptor is not pointing to it.

(4-5) HPC

Case 1 : 99% hit	Case 2 : 97 hit	Case 3 : 80 r. hit
~~0.99 + 0.02 x~~		
Avg. acc. time = 2 cycles	Avg. acc. time = 4 cycle	Avg. acc time = 20 cycles

→ latency of main memory is 100 times more than the latency of cache.
Consider, for cache = 1 cycle
then for mm = 100 cycle.

Computation Throughput

Memory access Throughput.

64 bit DDRAM

Processor
↳ Cores
↳ Frequency
↳ Flops/sec.
↳ $\frac{\text{Flops}}{\text{cycles}} \times \frac{\text{cycles}}{\text{second}} \times$ No. of cores.

Memory
↳ Frequency of memory system
↳ channels.
↳ Bytes/sec.

Peak memory access throughput

$= \left(\frac{\text{No. of bytes per transfer}}{8}\right) \times \left(\frac{\text{Trasfers per cycle}}{2}\right) \times \text{No. of channels}$

DDRAM →

(Transfers/channel) per cycle

$\times$ (Frequency) cycles/second.

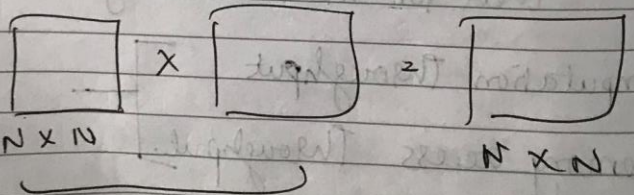
17/01/2020

(8-9) HPC

Optimizations of serial code.

Revision → Cache

Matrix multiplication



Input

Patterns → (i) Temporal locality (Future use) (Cont. access)
(ii) Spacial locality (Reuse)

$O(n^3)$ → Time } $O(3N^2)$ → Memory

Compute to Memory access ratio (CMA) = $\frac{2N}{2N} = 1$

↳ Maybe $\frac{2N}{2N+1}$?

No. of channels

Two types of code: (i) memory bound code
(ii) Compute bound code
(iii) Intermediate.

CMA ≈ 1 (then Intermediate)
↳ most linear algebra algos.

CMA < 1 (memory bound)

CMA > 1 (compute bound)

Block size → 32 or 64 byte (Together 32 or 64 bytes are accessed)
↳ Cache lines

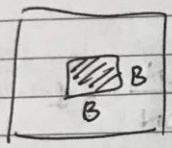
Cache size << N (One row does not fit into Cache)

first iteration
↳ Total no. of misses = $\frac{N}{8} + N = \frac{9N}{8}$

for column
(Because stored in row major)

Total no. of misses = $\frac{9N}{8} \times N^2$ ← $\because 9N/8$ for output

Block Matrix multiplication.



Block → B×B

Assume, $(3B^2 < C)$ & $(C << N)$

First iteration

↳ $\frac{B^2}{8} \times \frac{2N}{B} = \frac{NB}{4}$

Total no. of blocks = $\left(\frac{N}{B}\right)^2$

Total no. of misses = $\frac{NB}{4} \times \frac{N^2}{B^2} = \frac{N^3}{4B}$

Misses	Type
$\frac{9N^3}{8}$	No blocking
$\frac{N^3}{4B}$	Blocking

Speedup = $\frac{9N^3}{8} \times \frac{4B}{N^3} = \frac{9B}{2}$

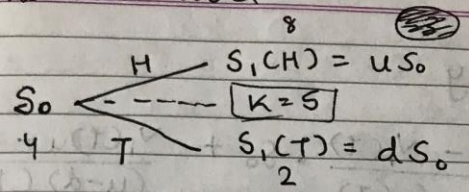
suppose, B=8

speedup = 36

B=16 speedup = 72

Comp Finance

(9-10) Binomial Model



→ r ~ risk free rate is given. $[1 \to 1+r]$

Eg- $S_0 = 4$, $u = 2$, $d = 1/2$, $r = 1/4$

→ Let V_0 be the worth of the call option at $t=0$.

$V_1(H) = S_1(H) - K = 3$

$V_1(T) = 0 = 0$

Replication: Consider a hypothetical portfolio (x, y)

$x \to$ amt. of stock

$y \to$ amt. of money in bank at time $t=0$

$$xS_1(H) + y(1+r) = V_1(H)$$

$$xS_1(T) + y(1+r) = V_1(T)$$

$$x(S_1(H) - S_1(T)) = V_1(H) - V_1(T)$$

$$x = \frac{V_1(H) - V_1(T)}{S_1(H) - S_1(T)}$$

$$y = \frac{V_1(T)u - V_1(H)d}{(u-d)(1+r)}$$

$$V_0 = xS_0 + y$$

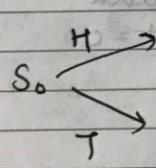
$$= \frac{V_1(H) - V_1(T)}{S_1(H) - S_1(T)} \cdot S_0 + \frac{V_1(T)u - V_1(H)d}{(u-d)(1+r)}$$

$$V_0 = \frac{1}{1+r}\left[\frac{V_1(H)(1+r-d)}{u-d} + V_1(T)\frac{(u-1-r)}{u-d}\right]$$

Consider $\frac{1+r-d}{u-d}$, $\frac{u-1-r}{u-d}$ as probabilities.

→ Suppose option was worth 1.21
↳ 0.01 aside

$t=0 \rightarrow 1.2$
Borrow $\rightarrow$ 0.8
2.0
↳ Buy ½ stock.



	Stock	Bank	option
$t=1(H)$	$\frac{1}{2}8=4$	-1	-3
$t=1(T)$	$\frac{1}{2}2=1$	-1	0

→ Now, suppose option price was 1.19

	Stock	Bank	option
$t=1(H)$	$-1/4-2$	$-1.19(5/4)$	3
$t=1(T)$	$0-1$	$-1.19(5/4)$	

(10-11) NLD.

$x' = rx - x^2 = -\left[x^2 - 2rx + \frac{r^2}{4} - \frac{r^2}{4}\right]$

$x^* = 0, r$

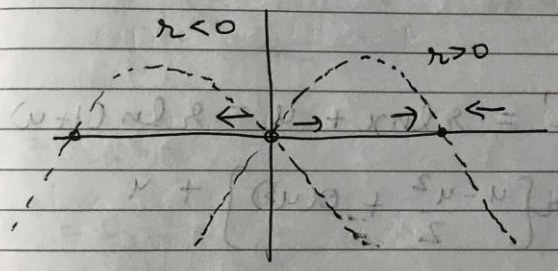
$= \frac{r^2}{4} - \left(x - \frac{r}{2}\right)^2$

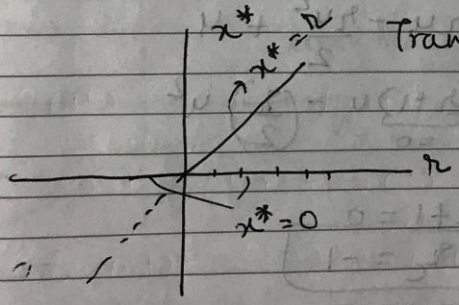
$f'(x) = \frac{\partial f}{\partial x} = r - 2x$

$f'(0) = r$ $\qquad$ $f'(r) = -r$

$r > 0$ unstable $\qquad$ $r > 0$ stable

$r \leq 0$ stable $\qquad$ $r < 0$ unstable





Transcritical bifurcations.

Transcritical bifurcations → for $r > 0$ x stable y unstable $r = 0$ x & y half stable & $r < 0$ x unstable y stable.

$x' = rx - x^2$

LASER → self organization. *

$$\frac{dn}{dt} = G(N_0 - \alpha n)^n - kn$$

$$= (GN_0 - k)n - \alpha n^2$$

$$\frac{dn}{dt} = c_1 n - c_2 n^2$$

$$n^* = 0, \frac{c_1}{c_2}$$

Eg- $x' = r \ln x + x - 1 \qquad x^* = 1$

$u = x - 1$

$u' = x' = r \ln x + u = r \ln(1+u) + u$

$$u' \simeq r\left[u - \frac{u^2}{2} + O(u^3)\right] + u$$

$$\simeq ru - \frac{ru^2}{2} + u$$

$$u' \simeq \underbrace{(r+1)}_{=0} u - \left(\frac{r}{2}\right) u^2$$

$$\boxed{r + 1 = 0}$$

$$\boxed{r_c = -1}$$

$x' = r + x^2$

$x' = rx - x^2$

$x' = rx - x^3 \rightarrow x = -x$ (Symmetric)

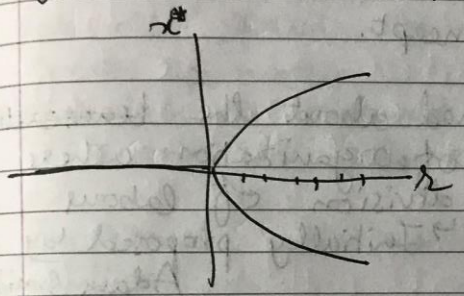
$\dot{x} = rx - x^3$ → Supercritical pitchfork bifurcation

$x^* = 0, \pm\sqrt{r}$

$f'(x) = r - 3x^2$

$f'(0) = r$, $f'(\pm\sqrt{r}) = -2r$

↑ Just for $r > 0$ as $\sqrt{r}$.

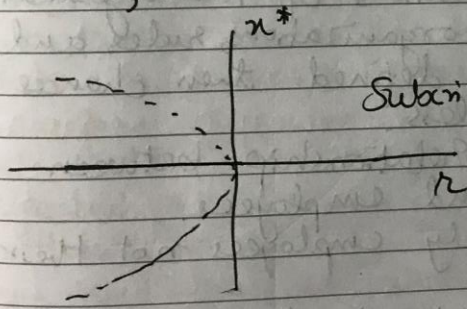


Pitchfork bifurcation.

+4

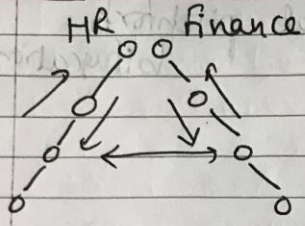
$\dot{x} = rx + x^3$

$x^* = 0, \pm\sqrt{-r}$



Subcritical pitchfork bifurcation.

(11-12) 013



Henry Fyol. in diff. department

People of same level can talk to each other.

Gangplank concept

→ Gangplank concept.

"Max Weber explained about the ~~bureaucratic~~ beaurencritic type of organization where

(i) Imp to have division of labour
↳ Initially proposed by Adam Smith

(ii) Imp to have well defined hierarchy. (who is reporting to whom). (Chain of command)

(iii) Rules & regulations of the organization.
→ If in an organizations, rules and roles are properly defined then chances of conflict are less.

(iv) Impersonal relationship between managers and employees.
(Know only employees not their families)
→ They have rational decision making process rather than being influenced by favouritism & personal prejudice.

(v) Competency
→ Promotions, assignments, hiring all is based on competency. If people are competent they are rewarded, awarded.

(vi) Records.
→ Believe in keeping all records.

Fredrick Taylor's contribution.
→ exp. about type of payment & work done.
→ Depending on the hours of work, the salary is fixed. No. of hours more, the salary is more.
↳ They have framework in org. Comb- of diff. theories adopted in org's.

→ Situational questions based on topics studied
(i) Happy workers need not be productive. Explain
(ii) How does humanskill help managers to get desired goal & with example?
(iii) Employes at flash technologies felt constantly demotivated by the behaviour of their new boss Narendra Reddy. Reddy was fond of giving instructions and directing his stuff on how to do their work. He expected them to follow his instructions without questioning him. He hated receiving any kind of suggestions from the subordinates. His staff considered him to be a one way communicator. Which type of manager is Reddy? Discuss typical characteristics this type of people have.

(i) Happy workers need not be productive.

→ ~~There can be two type of workers. First the ones who are happy because they are working in their field of interest and so they would be happy because of their progress in their work. They will be happy achieving~~

→ Only those workers who are happy because they are working in their field of interest and they have the proper skillset to work in their field and will & always try to achieve the required work will be productive

→ Those workers who are happy because they don't need to complete their work due to any of the reasons like some other worker might be in his team who does the work or their is very less amount of work in his field or maybe he is not inquisite for working more in that field then he won't be productive.

20/11/20

OS (9-10)

→ I/O redirection

→ Normally, output is goes to stdout But if we want to store the output in file named abc then write func() > abc
somepgm > abc (Not displayed just written on file)

→ dup() allows to make changes to file descriptor table.

→ dup() allocates smallest unused file descriptor on passing an oldfd. Copied the pointer.

→ On calling dup() → the file descriptor pointing to a struct. dup() returns fd pointing to same struct. so, we can use any of them.

→ The flags are respective to the file descriptor.

→ Commands for creating opening file with diff. flags.

close(1) → closing stdout
↳ fd for stdout

→ On closing fd1 we do dup(3) ↳ ∴ new file at 3.
dup finds '1' as the lowest unused fd. So, copies index 3 pointer to 1 fd.

→ So, now fd of stdout points to our file. So, the output will be written in the file

→ Now, fd 3 pointing to new file will close on close(fd) ↳ only closes the passed fd.

→ On calling exec(), the file des. tables will be intact because it is in Kernel memory.
→ So, on system calls for replacing process memory, the things in kernel memory will remain intact.
→ We do this everything in child process because otherwise whole shell will get wiped out. So, not to flush out all process (master process) child processes are created & work is done.

Ch. 40

Inode file system metadata to be stored in the disk only.

64 Blocks → 8 blocks metadata
(56 blocks data (Data region)
↳ 5 blocks inode (file name not stored here)

→ No. of files we can have is equal to the no. of inodes in the memory.
↳ 5 blocks = 80 inodes
~~Inode (opt) size~~ ↳ if 1 inode = 256 bytes

∴ max no. of files = 80 files

→ For keeping track of these data blocks & inodes we require two pointers ↳ called bitmap.
→ One bit per node & one bit per datablock required originally.
→ Block of no use is called super block. It stores metadata for whole file system.

will be
l memory
process
nemory will

process
will get
all process
are created

red in the

ta region)
name not
tored here)
ual to the

nodes
↳ if 1 inode
= 256 bytes

locks &
tes
called
bitmap.
datablock

ock. It
lesystem.

model & Sim (12-1)

$\frac{dx}{dt} = rx\left(1-\frac{x}{k}\right)$ (i) Model for k
(ii) Quantitative
(iii) why fig ①?
(iv) what if system is discrete?

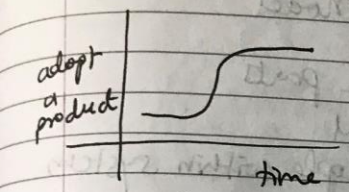
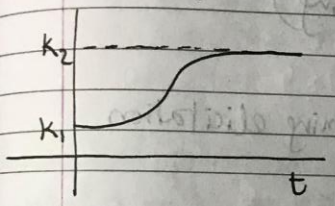


fig ①



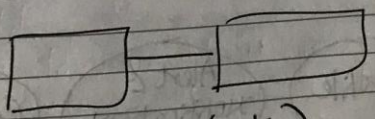
$\frac{dk}{dt} = \sim k(1-k)\sim$ ①

→ $\frac{dx}{dt} = rx\left(1-\frac{x}{k}\right)$ → In this eqⁿ we find two points using

$\frac{dx}{dt} = 0. \quad x = 0, k$

So, here we want $x = k_1, k_2$
↑ eqⁿ ①

→ Finding the constants, we can change one eqⁿ to two coupled eqⁿ and can be considered as two compartments.



$\frac{dk}{dt} = \odot(k-k_1)\left(1-\frac{k}{k_2}\right)$ $\quad \frac{dx}{dt} = rx\left(1-\frac{x}{k}\right)$

↳ Shouldn't here be $(k-k_1)$?

$$N(t+\Delta t) = N(t) + N \times f\left(\frac{C-N}{C}\right) \times \Delta t$$

$$\frac{dN}{dt} = fN\left(\frac{C-N}{C}\right)$$ } Bass Model

Splits problem into 2 parts

(i) External
↳ Any external influence (like advertising)

(ii) Internal
↳ People within system

22/01 SEN (8-9)

- Brainstorming elicitation

Concept mapping

logout and login

Contact us
↳ more generic

ATM & Bank locations

login

↳ Should be generic/compatible to updates for see. After login

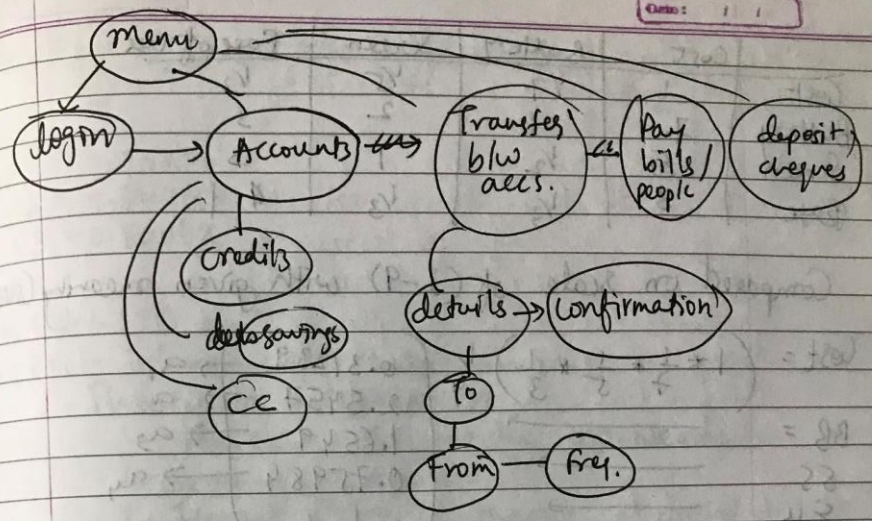
Menu

Profile

Alert & Notifications

Contact us
↳ Registered Mob. no

* Concept Mapping



Requirements prioritization.
Why? → can't go through all requirements in single code.

1. Ranking (Individual)
2. Numerical assessment (Grouping) [Ranking to groups]
3. MoSCoW
   must have should have could have won't have
   would
4. Bubbles sort [compare two req. & prioritize]
   ↳ largest no. in array
5. Hundred Dollar method [give to stakeholders & prioritized based on their investment in the requirements]
6. Analytical Hierarchy Process

Eg - Purchase a smartphone] Goal

criteria: Cost, Battery, Screen size, Ease of use

alternatives: → phones P_1 P_2 P_3

	Cost	Battery	Screen	Ease of use
Cost	1	1/7	1/5	1/3
Battery	7	1	2	3
Screen	5	1/2	1	3
Ease	3	1/3	1/3	1

Compared on scale of (1-9) with given meanly (divide)

Cost = $\left(1 * \frac{1}{7} * \frac{1}{5} * \frac{1}{3}\right)^{1/4}$ → 0.31239 → a_1

BB = → 2.5457 → a_2

SS = → 1.6549 → a_3

Eu = → 0.75984 → a_4

→ normalize by dividing by 5.2728

→ sum all of them = 5.2728 → S

weights → $A_2 = \begin{bmatrix} a_1/S \\ a_2/S \\ a_3/S \\ a_4/S \end{bmatrix}$ Cost, Battery, Screen, Eu

→ sum should be 1.

	Cost	Battery Screen	Screen Battery	Eu
P_1	18000	4000	5.6	5
P2	11000	3000	6	3
P3	16000	2500	5.2	8

	Cost	Battery	Screen	Eu
P1	11/15	4/4	5.2/5.2	5/8
P2	11/11	3/4	6/6	3/8
P3	11/16	2.5/4	5.2/5.2	8/8

$P_1 = \left[\left(\frac{11}{15} * \frac{4}{4} * \frac{5.2}{6} * \frac{5}{8}\right) * 0.0592\right] \begin{bmatrix} A_2 \\ \vdots \end{bmatrix}$

P1 = 0.90774
P2 = 0.7474
P3 = 0.80043

OB (10-11)
last lec - Human skills help managers.
- Theory of Motivation
  - Maslow's Hierarchy of Needs
  - Iceberg metaphor
  - Henry Fayol's theory
  - Henry Heltzberg's managerial roles
  - OB model
- Cognitive Dissonance
  - ↳ We keep on procrastinating
  - ↳ Inconsistency in people about belief system

~~Communication~~
↳ ~~Lady~~ Meaning?

→ Masow Hierarchy Needs

Self actualization (personal growth.
↑
Esteem needs (status, achievement, responsibility)
↑
Love needs (family)
↑
Safety needs (Security, Investment, LIC)
↑
Biological & Physiological Needs
↳ must for everyone (Roti, Kapda, Makan)

→ Henry Fayol's Traditional theory of management
→ Henry Herdsberg: Key managerial roles.

OB model:
This model explains structure of functioning style & working, performance & people dependent on structure, functioning performance how people are at work.
→ Style & func. is what in OB model depending on it, understanding human behaviour.

4 OB models

→ Autocratic
Eg - Based on power, money, authority
→ Based on hire & fire policy
→ Don't try to act smart.
→ Always dictating manages
→ Dependence on boss (Boss is right)
→ Employee needs are subsistence
→ Performance is minimum.
→ I will not show creativity not happy in organization

Custodial
→ It is based on economic resources i.e. money oriented.
→ I throw money & you have to work.
→ Security & benefits
→ Dependency is on the organization.
→ I have money i.e. more than expectation
→ Passive cooperation (Jaha hai ne sir)

Supportive

→ I will help you.let form good team.
→ Support
→ I am allow to show creativity.
→ I participate in organization.
→ I am happy in organization
→ I am having status, recognition.
→ My initiative to work in organization (Not push to go to office)
→ Doing work happily (Awakened drives)
~~→ Moderate~~

Collegial

→ Friend in need is friend indeed.
→ Partnership
→ Responsible behaviour
→ Friendship plays important role.
→ Self actualization (Friend doesn't hold hand always).
→ Moderate enthusiasm

Eg.

→ Custodial : IBM
→ Supportive : Tata, HP
→ Collegial : R&D type

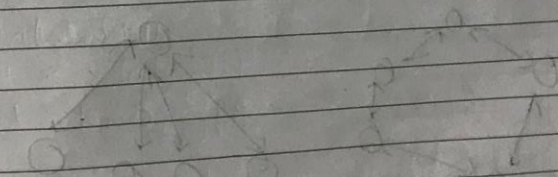
→ No company works on single model. Eg- Finance dept. works as custodial, HR works as supportive.
→ It is mixture of these models. This is a hidden aspect of OB.

→ According to diff. situations, diff. places, people to people, behavioral diff, impact of the model is dependent on people's behavior. So, it is combination of all & not single way of functioning.

→ Understanding people's behavior, perception,

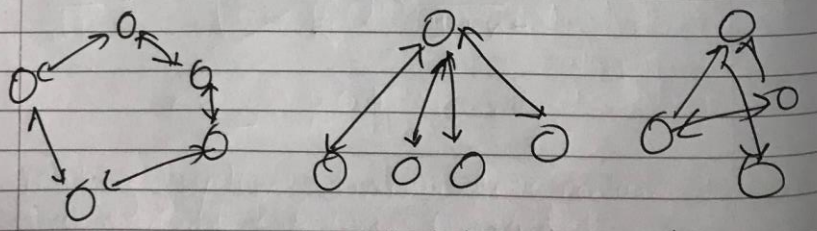
laces,
impact of
ople's
all &

erception,



- Grievance ~~procedure~~ procedure is a suggestion boxes that are used. The problems are written & put in box. One person reads & conveys up.
- Open door policy → Walk in anytime to meet bosses without appointments.
- People leave org.: A good org. uses the reason of people leaving org. for making improvements
- Participation Techn.: A group of people brain storm to solve the issues of the employees.
- The ombudsperson → No grievances box but similar. Like in education system. A person whom to convey problem. He takes up brings down.

Horizontal communication → Gangplank concept.



interactive cross

Other type: virtual type

(11-12
Questio
Ch.3
Insect
↳ spr

(11-12) NLD & Chaos Steven Strogatz.

Questions for exam

Ch.2 Flow on a line

2.2.1 - 2.2.7
2.2.12, 2.2.13
2.3.1 - 2.3.4
2.4.1 - 2.4.8

Also, plotting functions

Ch.3 Bifurcation

3.1.1 - 3.1.5
3.2.1 - 3.2.4
3.3.1 •
3.4.1 - 3.4.10
3.4.11 "
3.4.15
3.6.2 *
3.7.3
3.7.6

Insect outbreak problem -

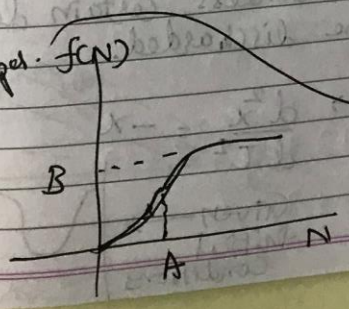
↳ spruce budworm

N - Number density of insects.

$$\frac{dN}{dt} = rN\left(1 - \frac{N}{K}\right) - f(N)$$

↳ due to predation by birds.

Judging by the paper.



$$f(N) = \frac{BN^2}{A^2 + N^2}$$

x^* vs. r phase-space diagram
Bifurcation diagram

$$\frac{dN}{dt} = rN\left(1-\frac{N}{K}\right) - \frac{BN^2}{A^2+N^2}$$

→ Two variables : N & t
→ "Make these two dimensionless. In the procedure hope that no. of parameters come down."

Take: $n = \frac{N}{N_0}$ $\tau = \frac{t}{t_0}$

$$\frac{N_0}{t_0}\frac{dn}{d\tau} = rN_0 n\left(1-\frac{nN_0}{K}\right) - \frac{BN_0^2n^2}{A^2+N_0^2n^2}$$

$$\frac{dn}{d\tau} = rt_0 n\left(1-\frac{n}{K/N_0}\right) - \frac{Bt_0}{N_0}\left[\frac{n^2}{\frac{A^2}{N_0^2}+n^2}\right]$$

Let $N_0 = A$, $t_0 = \frac{A}{B}$, $r = \frac{rA}{B}$, $k = \frac{K}{A}$

$$\frac{dn}{d\tau} = rn\left(1-\frac{n}{k}\right) - \frac{n^2}{1+n^2}$$

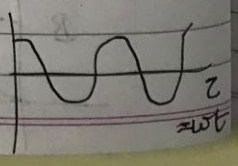
r & k to worry.

→ Making system dimensionless, certain dep. on constants can be discarded.

$$\frac{d^2x}{dt^2} = -\omega^2 x \rightarrow \frac{d^2x}{d\tau^2} = -x$$

$\tau = \omega t$

Given initial conditions →



$$\frac{dn}{d\tau} = rn\left(1-\frac{n}{k}\right) - \frac{n^2}{1+n^2}$$

(i) Fixed points $n^* = 0$,

$$rn\left(1-\frac{n}{k}\right) - \frac{n^2}{1+n^2} = 0.$$

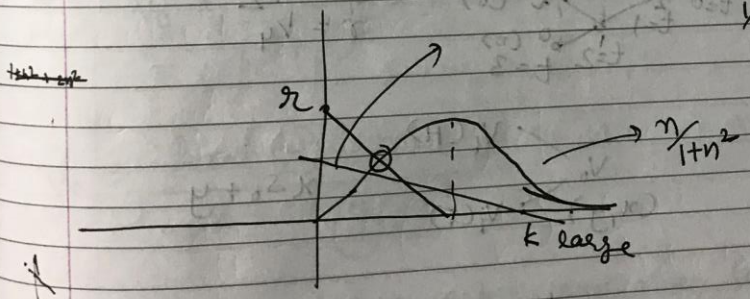
$$\text{or } r\left(1-\frac{n}{k}\right) - \frac{n}{1+n^2} = 0 \text{ and } n = 0.$$

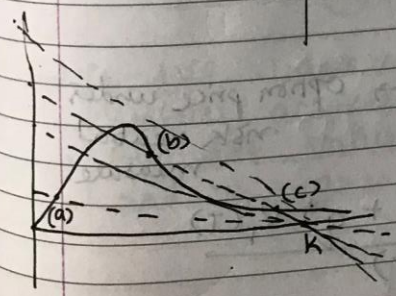
$n^* = 0 \rightarrow$ unstable as close to zero 'rn', So exponentially diverging.

$$r\left(1-\frac{n}{k}\right) = \frac{n}{1+n^2}$$

$n << 1$, $\frac{n}{n}$

$n >> 1$, $\frac{1}{n}$





For $r << \rightarrow$ (a)

$\uparrow r \rightarrow$ (b, c) & (a)

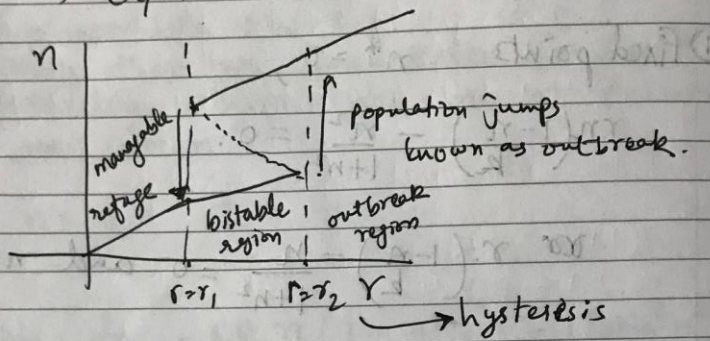
$r = r_1$ (saddle node bif.

$\uparrow r \rightarrow$ (b), (c) & (a)

$\uparrow r \rightarrow$ (a), (b) vanish

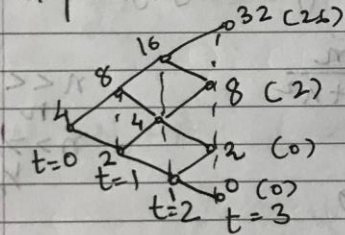
$r = r_2 \rightarrow (a, b)$ & (c)

$\uparrow r \rightarrow (a, b)$ vanishes & (c)

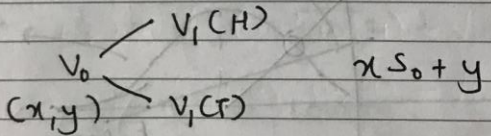


(12-1) Comp. Finance

Multiperiod binomial model



$S_0 = 4$
$u = 2$
$d = 1/2$
$r = 1/4$
$K = 6$



$V_0 = \frac{E^*(V_1)}{1+r}$ → option price under risk neutral measure.

$= \frac{p^* V_1(H) + q^* V_1(T)}{(1+r)}$

$p^*, q^* = 1/2$ $\quad \frac{1+r-d}{u-d}$ (risk neutral measure)

~~$V_2(HH) = p^* V_3(HHH) + q^* V_3(HHT)$~~

$$V_2(HH) = \frac{p^* V_3(HH\bar{H}) + q^* V_3(HHT)}{1+r}$$

$$V_2(HT) = V_2(TH)$$

$$= \frac{p^* V_3(THH) + q^* V_3(THT)}{1+r}$$

$$= \frac{1/2\,(2) + 1/2\,(0)}{5/4}$$

$$= 4/5$$

$$* \quad V_0 = \frac{\mathbb{E}^*(V_N)}{(1+r)^N}$$

$$V_0 = \frac{26 \cdot \left(\frac{1}{2}\right)^3 + 2\left(\frac{1}{2}\right)^3 \cdot 3}{(4/5)^3}$$

→ If diff. interest rates are given. Calculate values according to 'r' at each point.
→ Also, diff. values at each level for 'r' and 'u' can be given.

Multiperiod model

$$V_{n+1} = (V_n - \Delta_n S_n)(1+r) + \Delta_n S_{n+1}$$ ← Hedging argument

Δ_n = amt. of stock at time n

$\Delta_n S_n$ = Total value of stock

V_n = option price at time n

$V_n - \Delta_n S_n$ → put in bank

$$V_{n+1}(\omega_1 \omega_2 \omega_3 \dots \omega_n H) = (V_n - \Delta_n S_n)(1+r) + \Delta_n S_{n+1}(\omega_1 \omega_2 \dots \omega_n H) \quad \text{(1)}$$

$$V_{n+1}(\omega_1 \omega_2 \dots \omega_n T) = (V_n - \Delta_n S_n)(1+r) + \Delta_n S_{n+1}(\omega_1 \dots \omega_n T) \quad \text{(2)}$$

where ω_i are sequence of H & T.

$$\Delta_n(\omega_1 \dots \omega_n) = \frac{V_{n+1}(\omega_1 \dots \omega_n H) - V_{n+1}(\omega_1 \dots \omega_n T)}{S_{n+1}(\omega_1 \dots \omega_n H) - S_{n+1}(\omega_1 \dots \omega_n T)}$$

$$x = \frac{V_1(H) - V_1(T)}{S_1(H) - S_1(T)}$$

→ Stock holding at time 'n'.

→ eq" (1) × p^* + eq" (2) × q^*

$$p^* V_{n+1}(\omega_1\omega_2\omega_3\ldots\omega_n H) + q^* V_{n+1}(\omega_1\ldots\omega_n T)$$

$$= (V_n - \Delta_n S_n)(1+r) + p^* \Delta_n S_{n+1}(\omega_1\ldots\omega_n H) + q^* \Delta_n S_{n+1}(\omega_1\ldots\omega_n T)$$

$$= V_n(1+r) - \Delta_n S_n(1+r) + \Delta_n [p^* S_{n+1}(\omega_1\ldots\omega_n H) + q^* S_{n+1}(\omega_1\ldots\omega_n T)]$$

$$\rightarrow p^* S_{n+1}(\omega_1\ldots\omega_n H) + q^* S_{n+1}(\omega_1\ldots\omega_n T) = S_n(1+r)$$

Avg. return from stock market $\Leftarrow$ Money obtained by investing in bank.

Risk-Neutral def^n.

$$\therefore V_n = \frac{p^* V_{n+1}(\omega_1\omega_2\ldots\omega_n H) + q^* V_{n+1}(\omega_1\ldots\omega_n T)}{1+r}$$

$\rightarrow V_n = V_n(\omega_1\omega_2\ldots\omega_n)$ [Random variable]

V_0 only is not a RV. (fixed value paid)

$$\mathbb{E}^*(S_1) = S_0(1+r)$$

$$\mathbb{E}^*(S_{n+1}) = S_n(1+r)$$

23/1/20

(9-10) Modelling & Sim.

$$\frac{dN}{dt} = \left(p + \frac{qN}{C}\right)(C - N(t))$$

C → Total pop.

$N(t)$ → Adopted

$q = 0$ → No interaction & with time $N(t) \to C$.

$p = 0$ → logistic system

p → External → Anything that motivates an individual to adopt.

q → Internal.

Epidemiology (spread of virus) (S I R)
↳ comp. virus also
↳ rumours spread.

S → Susceptible
I → Infected
R → Recovered

N is large
S → I → R
- Incubation period
- Latent period
↳ Not considered

No death & No birth
So, N = S + I + R const.

$$\frac{dS}{dt} = -cp\frac{S}{N}I$$

$$\frac{dI}{dt} = cp\frac{S}{N}I - \gamma I$$

$$\frac{dR}{dt} = \gamma I$$

C → No. of contacts each individual made per unit time

→ $C \times \frac{S}{N} \times p \times I$

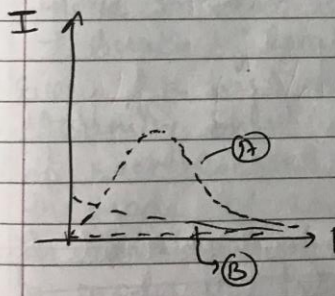
↳ prob. with which a susceptible takes virus

→ $\beta_f = C p$, $\beta = \frac{\beta_f}{N}$.

$$\therefore \frac{dS}{dt} = -\beta S I$$

$$\frac{dI}{dt} = \beta S I - \gamma I$$

$$\frac{dR}{dt} = \gamma I$$



Can show any behaviour like (A) & (B).
There exists a critical value for which we can see the behaviour changing from (B) to (A).

$$\frac{dI}{dt} = \gamma I \left(\frac{\beta_f}{\gamma} \frac{S}{N} - 1 \right)$$

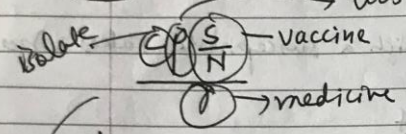
Initial ↓ Gaffes that it will cont. ↓

$$\frac{\beta_f}{\gamma} \frac{S_0}{N} \geq 1$$

↳ Initially most of the pop. will be susceptible. So, can be considered $\simeq 1$.

$R_0 = \frac{\beta_f}{\gamma}$ (Basic Reproduction Number).

$\frac{S}{N}\frac{\beta I}{\gamma} \rightarrow R_e$ = effective reproduction number



$\frac{1}{\gamma}$ = avg. time individual remains infected.

→ How many susceptibles will be infected by an infected individual over the time the individual remains infected.

SEN (10-11)

Actors — Customer → stakeholder

→ Cashier
~~→ Customer~~
~~→ Store~~
→ Catalogue system
→ Inventory system

Use cases:

- Handle sales
- Pay in cash, Credit card or cheque
- Issue gift coupons
- Handle returns.

Cashier

Print

Gift Coupons

Actors →

Use case de

(12-1) Os

→ Ins
↳

→ Ever

→ Ass
of
in

→ In
to

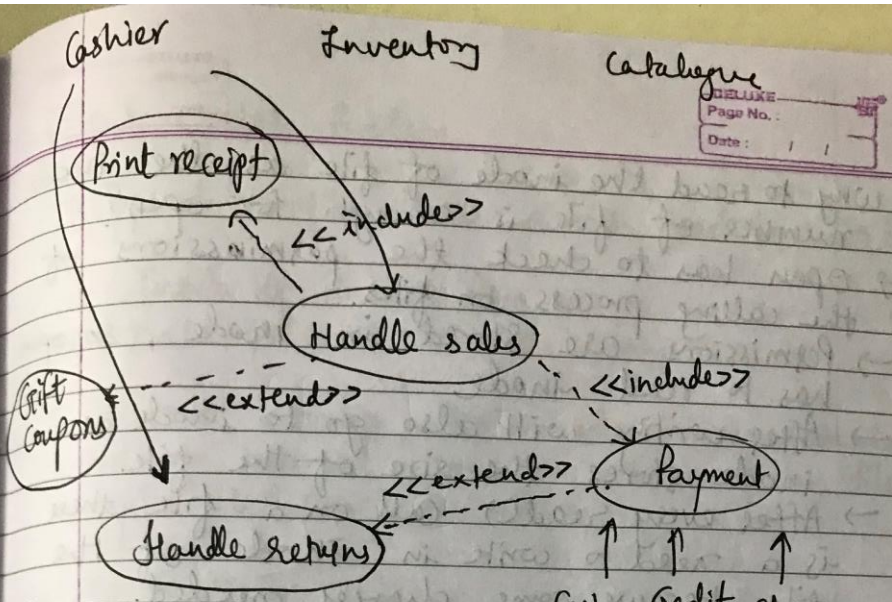
→ In
of
ino

→ Ins
the

→ Rea

→ e

→ Ope



Actors → Use cases → diagram
Usecase description ←

(2-1) OS

→ Inode for root is fixed.
  ↳ Bunch of location pointers of all datablocks
→ Every file has exactly one inode. datablock of root
→ Assuming only one block, read one block of root located using direct pointer present in inode of root.
→ ~~In datablock of root there will be a pointer to inode of foo (directory)~~
→ In datablock of root we find directory of foo. The directory file of foo will tell inode no. for bar.
→ Inode no. for foo is determined from the datablock of root.
→ Read inode for foo → corresponding data block
→ entry for inode of bar.
→ Open also reads the inode of bar. (?)

→ Why to read the inode of file as the inode number of file is enough for open?
→ Open has to check the permissions of the calling process on files.
→ Permissions are stored in inode, so open has to read inode.
→ After writing will also go to inode as inode stores the size of the file.
→ After every read() call on a file there is a need to write in inode of the file because some changes needed.
↳ last time accessed.
→ Timestamps of the files called through system calls are only updated.
→ What happens when we write 0 bytes?
↳ Try this, play with inode.

LFS, FFS (Book chapters)

Issues: Write a file. How to know which block to be allocated. Allocation policies.

Creat() → read inode bitmap → which inode free → allocate → write inode bitmap
C/B/A.

Allocate a new block → need to update inode
Space in available block → no need to update inode
→ But size is stored in inode. So, we need to always change inode of B.

Consistent Update Problem

→ Appending a file, what blocks need to write?

Inode of file :→ filesize
Allocate Data-block :→ Data Bitmap

↳ • data bitmap, file's inode, new datablock. ordering can be done in any way by file system. We can't do anything!

24/01/20 NLD (10-11).

$$\frac{dn}{dt} = rn\left(1-\frac{n}{k}\right) - \frac{n^2}{1+n^2}$$

$$r = \frac{rA}{B}, \quad K = \frac{K}{A}, \quad n = \frac{N}{A}, \quad \tau = \frac{tA}{B}$$

$n^* = 0 \rightarrow$ unstable.

$$r\left(1-\frac{n^*}{k}\right) = \frac{n^*}{1+n^{*2}}$$

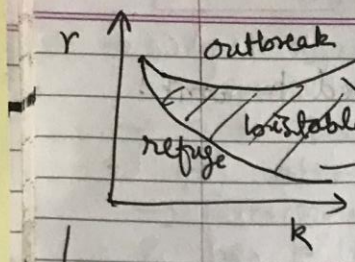
(i) $r\left(1-\frac{n^*}{k}\right) = \frac{n^*}{1+n^{*2}}$

(ii) $-\frac{r}{k} = \frac{(1+n^{*2}) - 2n^{*2}}{(1+n^{*2})^2}$

→ solve both eq^n's. (become tangent ∴ so slopes equal.)

solving for r, k

$$r = \frac{2n^{*3}}{(1+n^{*2})^2} \qquad K = \frac{2n^{*3}}{n^{*2}-1}$$



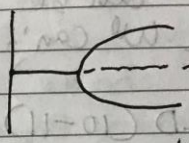
→ $r \downarrow$ → one fixed point refuge
$r \uparrow$ → outbreak

→ Boundaries → value of r & k for which we get saddle node bifurcation.

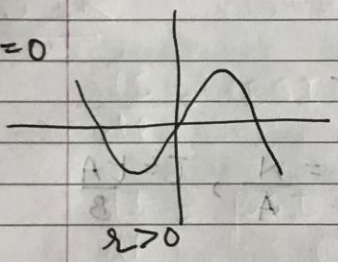
↳ In parameter space, we can know the behaviour.

Imperfect Bifurcation

$x' = h + rx - x^3$



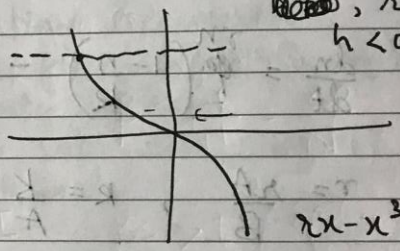
$h = 0$



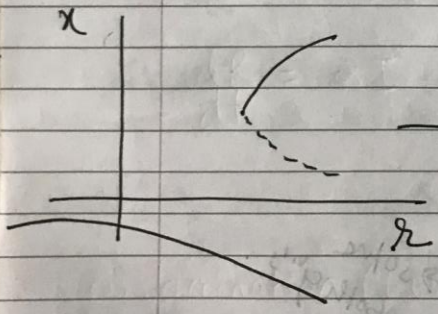
$r > 0$

$r < 0$

$h < 0$



$rx - x^3 = -h$



→ Such bifurcations are called imperfect bifurcation.
↳ happens when there is symmetry breaking.

$x' = rx - x^2 - h$
$- \beta x$
$- \beta x^2$

(i) Fixed points
(ii) Stability
(iii) Trajectory
(iv) Bifurcation
→ No imperfect bif.

OB (11-12)

Grapevine Characteristics

→ Finding out of information (through some trusted students) is known as Grapevine.

Rumours

(i) Spontaneous rumour
→ Rumours which spread during times of stress & are action oriented.

(ii) Predominated rumours
→ This rumours are deliberately created. Highly competitive. Create disturbance among people.

(iii) Wish fulfillment or pipedream rumours
→ Unfulfilled desires in terms of rumours

(iv) Anxiety or bogy rumours → due to fear
→ Reallocation, change transfer, work assignment.

(v) Wedge drivers
→ Negative rumours and because of hatred, aggression towards people or work.
→ They can easily go away when the management addresses the people properly.

(vi) Horse stretchers
→ Rumours are from ambiguity.
→ Delay from management to pass the information.
→ Not clear information, one might decision

→ dangerous rumours.

(vii) Curiosity rumours
→ originated due to curiosity among people.

How to deal with rumours?
(i) Communicating with people addressing them
(ii) Grapevine to find source
(iii) deal with source
(iv) Pay attention to type of rumours.

ModSim (12-1)

SIR – (China Karoda virus)

$$\frac{dS}{dt} = -\beta SI \qquad \beta = \frac{\beta_f}{N} = \frac{cp}{N}$$

$$\frac{dI}{dt} = \beta SI - \alpha I \qquad \frac{\beta s}{\alpha} > 1 \text{ (Epidemic threshold}$$

$$\frac{dR}{dt} = \alpha I \qquad \frac{\beta_f}{\alpha}\frac{S}{N} > 1$$

$R_0 = \frac{\beta_f}{\alpha}$ = Basic repr. no.

R_e = eff. reprod. no.

(i) Vaccination (Herd immunisation)
↳ Trying to move certain fraction of susceptibles & moves them to recovered.

p: fraction of susceptibles that are vaccinated.

$$\frac{R_e}{N}(1-p)S(0) < 1$$ (Vaccinate that much people so that epidemic doesn't happen)

↳ we want to bring down below threshold.

$(1-\rho) < \frac{N}{R_0 S(0)}$

$1-\rho < \frac{1}{R_0} \quad \left(\because S_0(0) \simeq N \left(\because N \text{ very large}\right)\right)$

$\rho > 1 - \frac{1}{R_0}$

Suppose, $R_0 = 3/2 \rightarrow \rho > 1/3$ (more than 1/3 pop. should be vaccinated) (But, vaccination expensive)

→ α calculated using data available for time required for diff. people to recover.

→ Expected value of time distribution is $1/\alpha$.

$$\frac{dS}{dt} = -\beta SI \; ; \; \frac{dI}{dt} = \beta SI - \alpha I \; ; \; \frac{dR}{dt} = \alpha I$$

$$\frac{dS}{dR} = \frac{-\beta S}{\alpha} = \frac{-R_0}{N} S$$

$$\ln S/S(0) = -\frac{R_0}{N}[R - R(0)]$$

$$\frac{S(t)}{S(0)} = e^{-R_0/N [R-R(0)]}$$

$$\lim_{t\to\infty} \frac{S(t)}{S(0)} = \frac{S(\infty)}{S(0)} = e^{-\frac{R_0}{N}[R(\infty) - R(0)]}$$

Assume, initially all are susceptibles & $R(0) = 0$, $S(0) = N$

$$\frac{S(\infty)}{N} = e^{-\frac{R_0 R(\infty)}{N}}$$

$N = S + I + R$

$t \to \infty \quad N \approx S + R$ (No infected)

$$\frac{N - R(\infty)}{N} = e^{-\frac{R_0 R(\infty)}{N}}$$

Let $\frac{R(\infty)}{N} = r$

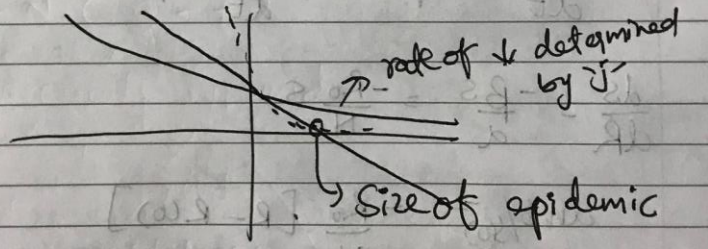
$$1 - r = e^{-R_0 r(\infty)}$$

→ At $t = \infty$ everybody infected will be recovered.
So, $r(\infty)$ = size of epidemic.

$$1 - r(\infty) = e^{-R_0 (r(\infty))}$$

Given R_0 → we can find $r(\infty)$ (size of epidemic)

$$1 - x = e^{-jx}$$



$s + i + r = 1$ $\left(s = \frac{S}{N} \text{ \& so on}\right)$

$t \to \infty \quad I(t) \to 0$

$s(\infty) + r(\infty) = 1$

→ All the susceptibles will not be infected But after a time all $I \to R$ so no longer infected people not absence of susceptibles

$$\frac{dS}{dI} = \frac{\beta S I}{\alpha I - \beta S I} = \frac{\beta S}{\alpha - \beta S} = \frac{\frac{\beta}{\alpha} S}{1 - \frac{\beta}{\alpha} S}$$

$$\frac{\beta}{\alpha} = \frac{R_0}{N}$$

$$\int \frac{dS\left(1 - \frac{R_0}{N} S\right)}{S} = \frac{R_0}{N} \int dI$$

$$\underbrace{\ln S - \frac{R_0}{N}(S + I)}_{\text{conserved quantity}} = \text{Const.}$$

$$= \ln(S(0)) - \frac{R_0}{N}[S(0) + I(0)]$$

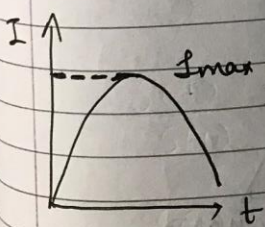
$S(0) = N$
$I(0) = 0.$

$$\ln(S(\infty)) - \frac{R_0}{N}(S(\infty) + I(\infty)) = \ln S(0)$$

$$I(\infty) = 0$$

$$\ln\left(\frac{S(\infty)}{S(0)}\right) = R_0\left(\frac{S(\infty)}{N} - 1\right)$$

$$R_0 = \frac{\ln \frac{S(\infty)}{S(0)}}{\frac{S(\infty)}{N} - 1} \qquad R_0 = \frac{\beta}{\alpha}$$

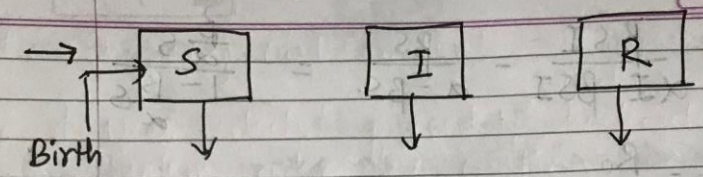


$$\left.\frac{dI}{dt}\right|_{I_{max}} = 0.$$

$$\beta S I - \alpha I = 0.$$

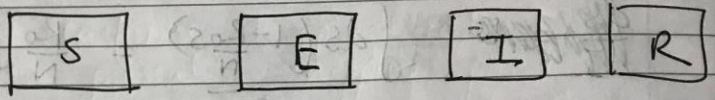
$$S = \frac{\alpha}{\beta} = \frac{N}{R_0}$$

$S + I \xrightarrow{\beta} 2I$
$I \xrightarrow{\alpha} R$
} Like chemical reactions



→ more the no. more the birth & more the death.

SEIR model.



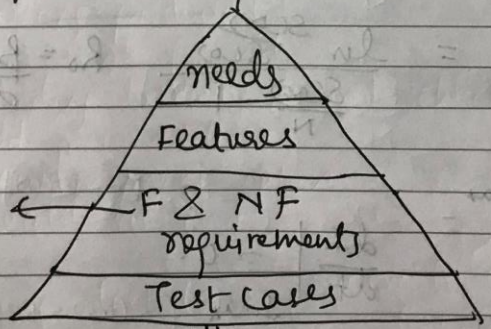
I + S → S becomes Exposed.
Time gap bet^n S & I. Exposed.

I → Ignorant, S → spreader, R - Stifles

$S + I \xrightarrow{\beta} 2S$
$S + S \rightarrow R + S$
$S + R \rightarrow 2R$

SEN (5-7)

Requirements Pyramid

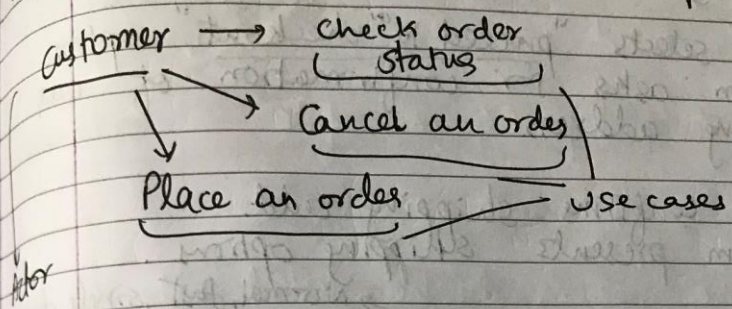


Use cases ← F & NF requirements

↳ Use cases will give us scenarios.

Differentiate between Scenario & functionality
(entering pin) (validation of pin)

→ Testers have access to requirements/specification only.



Use case Name: Place an order
Actor: Customer/User

Basic flow: → 1, 2, 3, 4... are scenario's.

1. User enters website address in the browser.
   System displays login page.
2. User enters an email address and a password. [email, password]
   System confirms correct login, presents main page, ~~prop~~ prompts for a search string.
3. User enters search string (partial name of the book) [Book_name_searched]
   System returns all books matching search criteria.
4. User selects a book.
   System presents detailed information about the book. [Book_name_selected]
5. User adds the book to a shopping cart.

Shopping cart contents is presented to user.

6. User selects "proceed to checkout" option.
   System asks for confirmation of ours shipping address.

7. Users confirms shipping add.
   System presents shipping options.

8. Users selects shipping options (→ Normal, fast, single day) and system asks which credit card to use.

9. Users confirms credit card info.
   System asks for final confirmation to place an order.

10. Users places and order.
    System returns a confirmation number.

Many alternative flows

(i) Wrong password
(ii) No book found
(iii) Adding to cart doesn't checkout
(iv) Add new address
(v) New payment option
(vi) Cancels at end

Identifying Test Cases [System level Test Cases] → as they are generated from requirements itself

(i) Identify variable name for each use case step. (Steps of basic flow)

(1) Identify significantly different options for each variable.

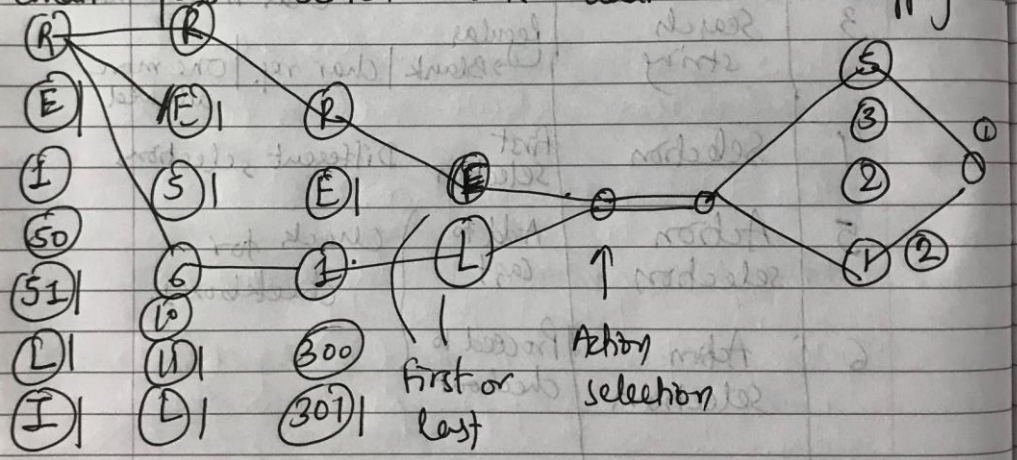
Steps	Variables	options to be tested
1	website	Actual url
2	Email password	Regular ← Blank? Chars req (max & min) Regular ← @ req. check from requirements Blank Chars min & max
3	Search string	Regular ↳ Blank | char req. | One more allowed
4	Selection	First selection — Different selections
5	Action selection	Add to cart — check for checkboxes.
6	Action selection	Proceed to checkout

One more allowed → Maximum errors are at boundaries. So we need to check boundaries. (Corner cases)
↳ Errors for '1' instead of '0' etc.

7. Shipping address → confirm address
8. Shipping method → 5 days, 3 days, 2 days, 1 day
9. Payment method → CC in a file
10. Final selection → Place an order.

(ii) Combine options to be tested into testcases.

email pass. search book add. checkout shipping ord



Check for
↓
Q→ Invalid

Testcase: Test I/p + Test scenario

If stopped at a point. Till then is called a test case

(iv) Assign values to the variables.

Step no.	Variable/ Selection	Value	Expected result	Actual result	Pass/ Fail	Comments
1	website	url	login screen			
2	email	ispatel @gmail.com				
3	password	xyz_123	main screen			

Agile → (i) Pupil
(ii) Test early
(iii) Code edely

Uses stories
As a ___, I need ___
so that ___

Front of card → user story (requirement)
Back of the card → Acceptance scenario.

Agile Process model → Important

1) Concept mapping
2) Uses stories
3) Use cases
4) Elicitation technique.

"Easy" Practice well

Closed open