EASTERN MEDITERRANEAN UNIVERSITY

COMPUTER ENGINEERING DEPARTMENT

CMPE 412 – SOFTWARE ENGINEERING

Final Exam

02 June 2017

DURATION: 150 min

Instructor: Assoc. Prof. Dr. Alexander Chefranov

Name Surname: ... ...

Student Number: ... ...

Instructions:

- There are **10** questions in total
- Questions Q1-Q5 (33 points) cover before- and Q6-Q10 (67 points) – after-MT material
- There are 19 pages in total.
- Calculators are allowed.
- GSM phones should be turned off and given to the invigilator.
- Passing any material including rubbers, pencils etc. to anybody else is strictly prohibited during the exam.
- Six sheets of handwritten paper may be used

QUESTION	GRADE
Q 1 (4)	
Q 2 (4)	
Q 3 (10)	
Q 4 (4)	
Q 5 (11)	
Q 6 (17)	
Q 7 (17)	
Q 8 (17)	
Q 9 (8)	
Q 10 (8)	
TOTAL (100)	

Before-MT QUESTIONS Q1-Q5 (33 points)

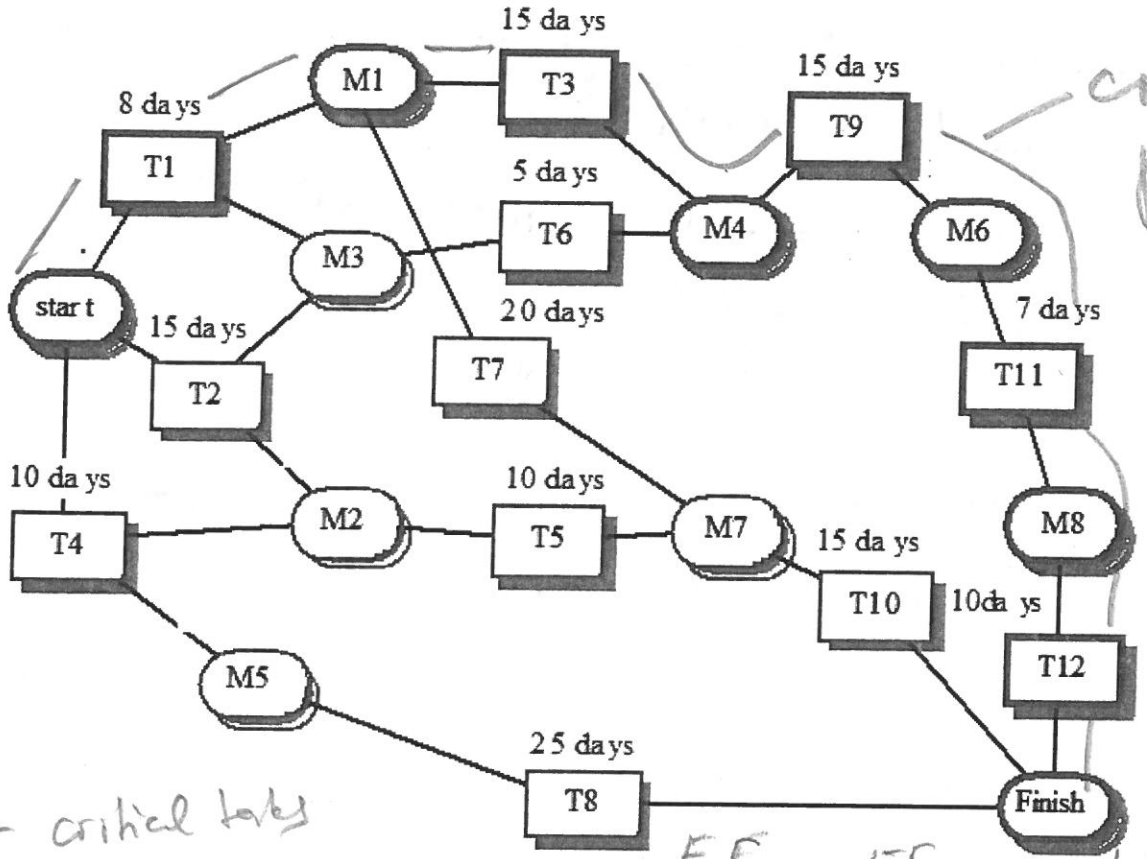
Q1 (4 points). What are the four most important goals of the Project Management?

- deliver the software to the customer at the agreed time;
- keep overall costs within budget;
- deliver software that meets the customer's expectations;
- maintain a happy and well-functioning development team

Q2. (4 points) Enlist six activities of a software project manager

- proposal writing
- project planning
- project scheduling
- estimating project cost
- monitoring progress and reviews
- writing reports and making presentations

Q3. (10 points) Consider the following activity network diagram



Define for the tasks T1-T12 where appropriate Earliest Start, Earliest Finish, Latest Start, Latest Finish, Slack (Total Float), and Drag times (assume that the 1st day is number 1, count work days only). Give definitions of the times mentioned. Explain your calculations.

Task	ES	EF	LS	LF	Slack	Drag
1 *	1	8	1	8	0	3
2	1	15	4	18	3	
3 *	9	23	9	23	0	3
4	1	10	21	30	20	
5	16	25	31	40	15	
6	16	20	19	23	3	
7	9	28	21	40	12	
8	11	35	31	55	20	
9 *	24	38	24	38	0	12
10	29	43	41	55	12	

11	*	39	45	39	45	0	7
12	*	46	55	46	55	0	10

Earliest start of a task not having preceding tasks is 1. If there preceding tasks, then it is maximal of their earliest finish plus 1. Earliest finish of a task is its earliest start plus duration minus 1.

Latest finish of a task not having succeeding tasks is the critical path length. Latest finish of a task having successors is minimal of the latest start of its successors minus one. Latest start of a task is its latest finish minus duration plus one.

Slack = LF - EF = LS - ES

Drag of a critical path task is its duration and slacks of the parallel to it tasks

Calculations are done according to the definitions above

Critical path tasks are denoted by * and have slack = 0.

Q4. (4 points) What are the four phases and six static workflows of the Rational Unified Process? How they are related to each other?

Phases: - inception
- elaboration
- construction
- transition

Static flows:
- business modeling (BM)
- requirements (R)
- analysis & design (AD)
- implementation (I)
- testing (T)
- deployment (D)

Inception is related mostly to BM & R
Elaboration to R & AD
Construction to I & T
Transition to D

Q5. (11 points) Compute the function point value, FP, for a project with the following information domain characteristics:

- Number of user inputs (External Inputs, EI): 10
- Number of user outputs (External Outputs, EO): 20
- Number of user inquiries (External Inquiries, EQ): 10
- Number of files (Internal Logic Files, ILF): 7
- Number of external interfaces (External Interfaces, EIF): 8

Assume that all complexity adjustment values are "AVERAGE". Explain your calculations.

HINTS: All ingredients necessary for FP calculation are given below

1) EI Table

FTR's	DATA ELEMENTS		
	1-4	5-15	> 15
0-1	Low	Low	Ave
2	Low	Ave	High
3 or more	Ave	High	High

Shared EO and EQ Table

FTR's	DATA ELEMENTS		
	1-5	6-19	> 19
0-1	Low	Low	Ave
2-3	Low	Ave	High
> 3	Ave	High	High

Values for transactions

Rating	VALUES		
	EO	EQ	EI
Low	4	3	3
Average	5	4	4
High	7	6	6

2) For both ILF's and EIF's the number of record element types and the number of data elements types are used to determine a ranking of low, average or high. A Record Element Type is a user recognizable subgroup of data elements within an ILF or EIF. A Data Element Type (DET) is a unique user recognizable, non-recursive (non-repeating) field on an ILF or EIF.

+8 EIF

RET's	DATA ELEMENTS		
	1-19	20 - 50	> 50
1	Low	Low	Ave
2-5	Low	Ave	High
> 5	Ave	High	High

7 → ILF

Rating	Values	
	ILF	EIF
Low	7	5
Average	10	7
High	15	10

3)

Type of Component	Complexity of Components			
	Low	Average	High	Total
External Inputs	x 3 = ___	x 4 = ___	x 6 = 10	60
External Outputs	x 4 = ___	x 5 = ___	x 7 = 20	140
External Inquiries	x 3 = ___	x 4 = ___	x 6 = 10	60
Internal Logical Files	x 7 = ___	x 10 = 7	x 15 = ___	70
External Interface Files	x 5 = ___	x 7 = 8	x 10 = ___	56
			Total Number of Unadjusted Function Points	386
			Multiplied Value Adjustment Factor	1.07
			Total Adjusted Function Points	413

4) 0: No influence

1: Incidental
2: Moderate
3: Average
4: Significant
5. Essential

$$sum(F_i) = \sum_{i=1}^{14} 3 = 42$$

$$0.65 + 0.42 = 1.07$$

5) FP = count-total x [0.65 + 0.01 x sum(Fi)]

FP = 413

After-MT Questions Q6-Q10 (67 points)

Q6. (17 points) For COCOMO II Application composition model,

PM = (NAP * (1 - %reuse/100)) / PROD,

estimate effort, PM, In person-months using the following data:

A Student course registration application will be reengineered with 30% reuse and have 4 screens (login, sysadmin, student, advisor) and will produce 3 reports (students' registered course number, advisors' confirmed student number, courses' registered student number). Each screen and report uses 4 database tables and has 1 view. The developers' experience is LOW, and CASE maturity is NOMINAL. Show your calculaions. Give necessary explanations.

HINTS:

Object Point Analysis - Screen

Number of views contained	Number and source of data tables: Total < 4 (<2 server, <2 client)	Total < 8 (2-3 server, 3-5 client)	Total 8+ (>3 server, >5 client)
< 3	Simple	Simple	Medium
3 – 7	Simple	Medium	Difficult
8+	Medium	Difficult	Difficult

Object Point Analysis - Reports

Number of sections contained	Number and source of data tables: Total < 4 (<2 server, <2 client)	Total < 8 (2-3 server, 3-5 client)	Total 8+ (>3 server, >5 client)
< 2	Simple	Simple	Medium
2 or 3	Simple	Medium	Difficult
> 3	Medium	Difficult	Difficult

Object Point Analysis – Complexity Weighting

Type of object	Complexity: Simple	Medium	Difficult
Screen	1	2	3
Report	2	5	8
3GL component	N/A	N/A	10

Figure 26.8 Object-point productivity

Developer's experience and capability	Very low	Low	Nominal	High	Very high
CASE maturity and capability	Very low	Low	Nominal	High	Very high
PROD (NOP/month)	4	7	13	25	50

Productivity $\frac{7+13}{2} = 10$

$$NAP = \underset{\text{Screens}}{4.1 + 3.2} = 10$$

$$PM = 10\left(1 - \frac{30}{100}\right)/10 = 0.7$$

Q7. (17 points) Consider Student course registration system (SCRS) with three actors: Sysadmin, Student, and Advisor. Define at least two services for each actor, draw a use-case diagram for SCRS, and describe scenario for some Student service.

HINT: Arrange the scenario as in the following example:

Initiating Actor: User

Actor's Goal: To view the heart rate readings for a day in the form of a line graph.

Participating Actor: Database

Pre-conditions: System displays the user's current month home screen.

Post-conditions: System displays the heart rate data for a day in form of a line graph.

Flow of Events for Main Success Scenario:

-> 1. User clicks on a day and then clicks on "View Daily Heart Graph".

<- 2. System sends request to database for the data.

->3. Database searches for user's data for the day and sends data to system.

<-4. System converts data to line graph and displays on the screen.

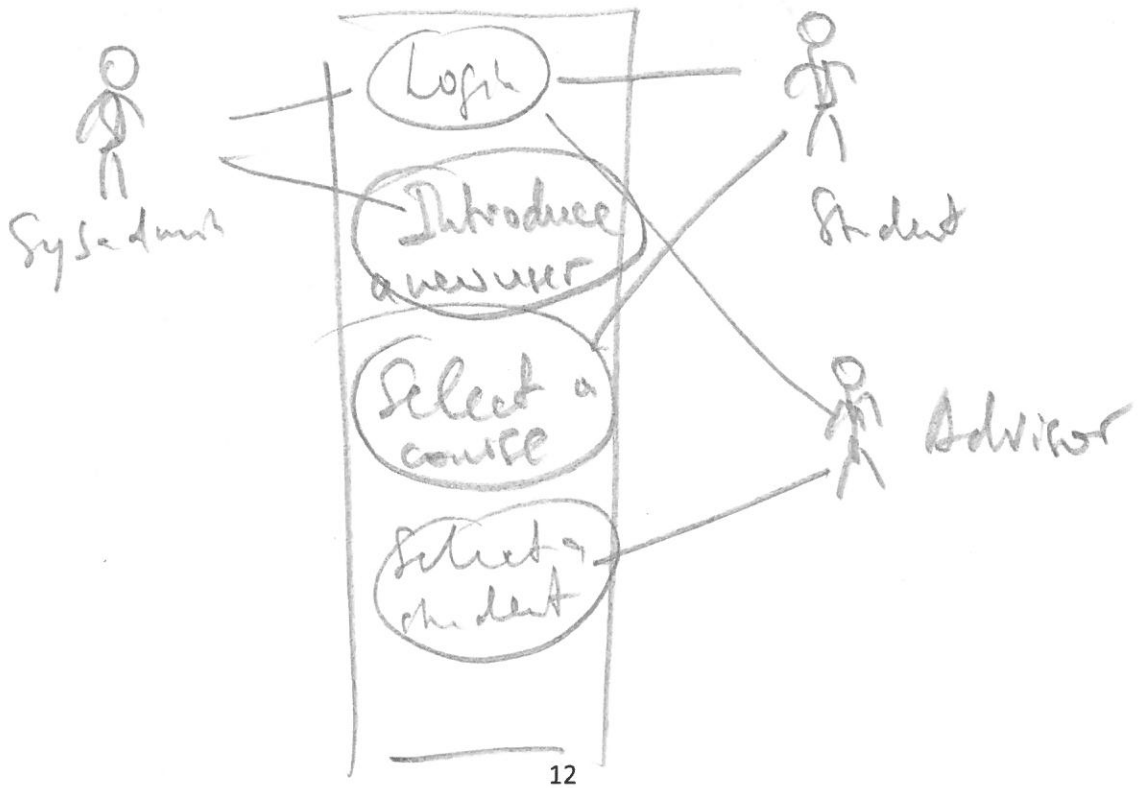
Flow of Events for Extension (Alternate Scenario):

-> 1. User clicks on a day and then clicks on "View Daily Heart Graph".

<- 2. System sends request to database for the data.

->3. Database searches for user's data for the day but does not find data.

<-4. System displays message "No data uploaded



Select a course

1. Initiating actor - Student
2. Actor's goal - To select a course in his program
3. Participating actor - na
4. Pre-conditions: Student has logged in, Student's program meets program conditions (≤ 5 courses per semester)
5. Post-conditions: Student's program meets program conditions

Main Success Scenario

Stud → Syst: show available courses
Syst → Stud: Available courses displayed "Select a course you want"
Stud → System: request on selected course including in the program
System: Checks for possibility of the course inclusion in the program

If possible:
System: Extends the student's program by the course selected
System → Student: List of the student's program courses are displayed

Alternative scenario

If extension is not possible
System → Student: Selected course can't be included in the program because of + reason of denial

Q8. (17 points) Consider set of tasks

Task ID	Preceding tasks	Optimistic (days)	Most likely (days)	Pessimistic (days)	Expected time	Variance
1		4	6	8	6	0,44
2		3	4	7	4 1/3	0,44
3	1	5	7	10	7 1/6	0,69
4	1	4	7	9	6 5/6	0,69
5	2,3	5	8	10	7 5/6	0,69
6	3	3	7	9	6 2/3	1
7	6	5	7	8	6 5/6	0,25
8	5	3	6	10	6 1/6	1,36

Build activity network diagram. Calculate expected duration and variance for each task and each path (fill in cells in the table above for the tasks and table below for the paths). Define critical path expected time and variance. For the critical path. Define probability of its completion in time equal to 1.1*Expected_Time(Critical_Path) (indicate by arrows in the Standard Normal Table how you find the probability)

Paths	Path tasks	Path expected time	Path variance
1	1-3-6-7	26 2/3	2,38
2	1-4	12 5/6	1,13
→ 3 critical path	1-3-5-8	27 1/6	3,18
4	2-5-8	18 1/3	2,49

HINT:

$$\text{Expected time} = \frac{\text{optimistic} + 4(\text{most likely}) + \text{pessimistic}}{6}$$

Variance is defined by: $\sigma^2 = \left(\frac{p-o}{6}\right)^2$

Where p, o are pessimistic and optimistic times

$$z = \frac{\text{specified time} - \text{path expected time}}{\text{path standard time}} = \left(\frac{D_T - EF_P}{\sqrt{\sigma_P^2}}\right)$$

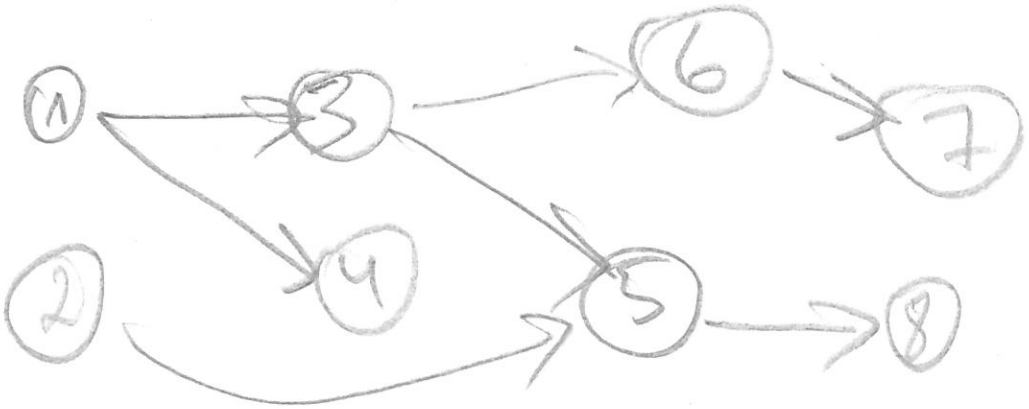
$D_T = 1,1 \cdot 27\,1/6 = 29,88$

$\sigma_{cr.path} = \sqrt{3,18} = 1,78$

Where D_T = the specified completion date

EFPath = the expected completion time of the path

σ_{Path}^2 = varianceof path



$$Z = \frac{\Delta t - Cr.path.time}{\sigma_{cr.path}} = \frac{29,88 - 27,17}{1.78} =$$

$$= \frac{2,71}{1,78} = 1,52$$

$$Prob(\Delta t) = 0,93574$$

1.52

STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
0.1	.53983	.54380	.54776	.55172	.55567	.55962	.56356	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91309	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
2.0	.97725	.97778	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
3.0	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900
3.1	.99903	.99906	.99910	.99913	.99916	.99918	.99921	.99924	.99926	.99929
3.2	.99931	.99934	.99936	.99938	.99940	.99942	.99944	.99946	.99948	.99950
3.3	.99952	.99953	.99955	.99957	.99958	.99960	.99961	.99962	.99964	.99965
3.4	.99966	.99968	.99969	.99970	.99971	.99972	.99973	.99974	.99975	.99976
3.5	.99977	.99978	.99978	.99979	.99980	.99981	.99981	.99982	.99983	.99983
3.6	.99984	.99985	.99985	.99986	.99986	.99987	.99987	.99988	.99988	.99989
3.7	.99989	.99990	.99990	.99990	.99991	.99991	.99992	.99992	.99992	.99992
3.8	.99993	.99993	.99993	.99994	.99994	.99994	.99994	.99995	.99995	.99995
3.9	.99995	.99995	.99996	.99996	.99996	.99996	.99996	.99996	.99997	.99997

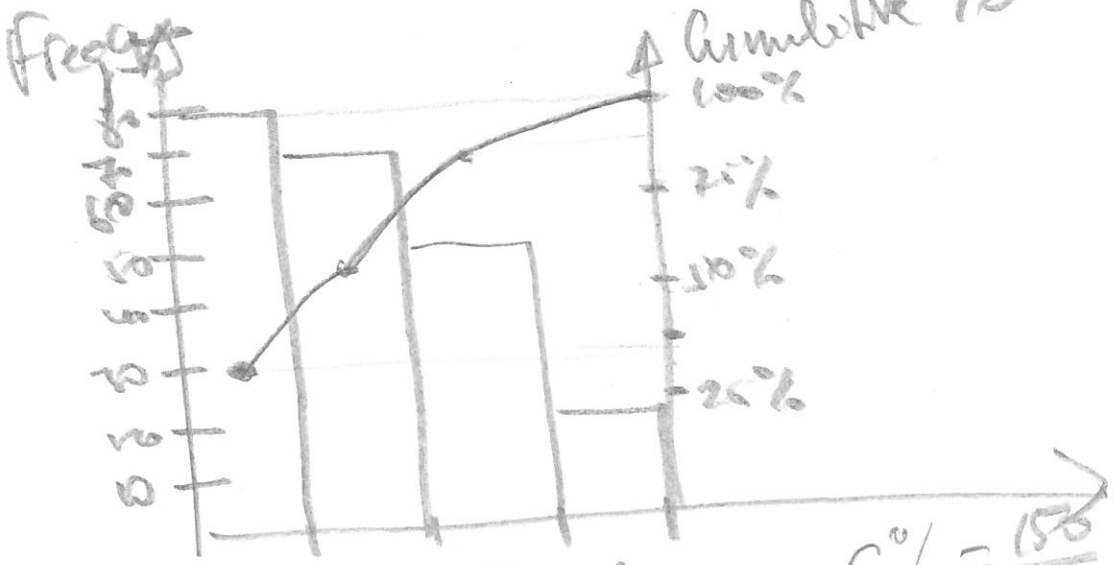
Q9. (8 points) For the following data, build the Pareto diagram and define two most influential factors

Complaint Category	Frequency/week
Customer is on hold too long	**50**
Customer gets transferred to wrong area or cut off	**70**
Service rep cannot answer customer's questions	**20**
Service rep does not follow through as promised	**80**

C_1
C_2
C_3
C_4

Order by Frequency decreasing

C_4 C_2 C_1 C_3
80 70 50 20



$C_1 + C_2 + C_3 + C_4 = 220$

$C_4\% = \frac{80}{220} = \frac{4}{11} = 36\%$

$C_2\% = \frac{150}{220} = \frac{15}{22} = 68\%$

$C_1\% = \frac{200}{220} = \frac{10}{11} = 91\%$

Q10. (8 points) What are the five main sources of change of the software configuration?

- New business conditions
- Customers' requests for changing
- Change of business size
- Budget constraints
- Errors detected