Foundations of Software Engineering (SS19)
Problem Set 3

Task 1: Effort Estimation - Function Points

A tracking system for warehouse inventory keeps track of what goods are stored in a warehouse. As boxes enter the warehouse, barcodes on the boxes that identify their contents are scanned and a record for each box is entered into a database of stored merchandise. As boxes leave the warehouse, their barcodes are scanned again by a different reader in order to remove them from that database. The barcode reader indicates the kind of content in the box; a table of codes and meanings determines the correspondence between code and box contents. A user can query the inventory database for the presence or absence of particular kinds of boxes in the warehouse.

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Step 1: Assign each requirement to one of:

- Input Data – External Input
- Outputs – External Output
- Queries – External Inquiries
- Data Sets – Internal logical Files
- Reference data – External Interface Files

Step 2: Classification of requirements (simple, medium, complex)
Step 3: Calculation unassessed FP
Step 4: Assessments of impact factors
Step 5: Calculation of the assessed FP
Step 6: Reading Effort in Person-months
Step 7: Update the empirical data

0 External Input
0 Internal Logical Files
0 External Output
0 External Interface Files
0 External Query

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a. Based upon this description, fill out the function point forms below and derive an estimate of the function points for this project.

Domain	Number of entities	Multipliers			Contribution
		Simple	Average	Complex	
External Input	2	3	4	6	6
External Output	1	4	5	7	4
External Inquiries	1	3	4	6	3
Internal Logical Files	2	7	10	15	20
External Interface Files	1	5	7	10	5

b. Calculate the raw (not assessed) function points.

- Unassessed FP: 6+4+3+20+5 = 38

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Impact factors on FP of the system:

- Interleaving
- Decentralized Data
- Transaction Rate
- Difficult Computing Operations
- Control Process
- Exemptions
- Complex Logic
- Reusability
- Data Conversion
- Configurability

Does the system require reliable backup and recovery?	0	1	2	3	4	5
Are specialized data communications required to transfer information to or from the application?	0	1	2	3	4	5
Are there distributed processing functions?	0	1	2	3	4	5
Is performance critical?	0	1	2	3	4	5
Will the system run in an exciting, heavily utilized operational environment?	0	1	2	3	4	5
Does the system require online data entry?	0	1	2	3	4	5
Does the online data entry require the input transactions to be built over multiple screens or operations?	0	1	2	3	4	5
Are the Internal Logical Files updated online?	0	1	2	3	4	5
Are the inputs, outputs, files or inquiries complex?	0	1	2	3	4	5
Is the internal processing complex?	0	1	2	3	4	5
Is the code designed to be reusable?	0	1	2	3	4	5
Are conversion and installation included in the design?	0	1	2	3	4	5
Is the system designed for multiple installations in different organizations?	0	1	2	3	4	5
Is the application designed to facilitate change and ease of use by user?	0	1	2	3	4	5

c. Assess the impact factors of the system using the following assessment table.

- IP: 5+1+1+2+2+1+1 = 13

d. Calculate the assessed function points.

- Final Assessed FP = unassessed FP * (0.7 + 0.01 * impact factors assessment))
- Assessed FP = 38*(0.7+0.01*13) = 31.54 ~ 32

e. Depending on historical database of project measurements, we know that it takes a developer an average of two person days of effort to implement a function point. Estimate the effort of developing this system in person days.

- 32*2 = 64 person days

 Nazrul.arif93@gmail.com

f. What are the advantages and disadvantages of the previous effort estimation method (Function Points)?

- Advantages:
  i. Starting point: product requirements, not LOC
  ii. Adaptable to different areas of application (change of categories)
  iii. Adaptable to new techniques (change of impact factors, impact assessment and weighting factors)
  iv. Refinement of the estimation in line with the progress of development (iterative method)
  v. First estimate already possible at early point in time (planning phase)
  vi. Fixed methodological steps
  vii. Easy to learn
  viii. Only requires little time effort
  ix. Good transparency
  x. Good estimation accuracy
  xi. Tool support available

- Disadvantages:
  i. Only the overall effort can be estimated
  ii. In its original form: personnel-intensive and cannot be automated
  iii. Too strongly related to functions
  iv. Quality requirements are not taken into account
  v. Mixture of project and product properties in impact factors
  vi. Original impact factors partly outdated today
  vii. Tends to underestimate as requirements are often incomplete
  viii. Methodological deficiencies

Task 2: Project Management – MPM Network Plans

Each of the following statements describes the relationship of two work packages(tasks). We want to represent each statement using MPM network plan technology. To do so, determine the task relationship type and the time interval between tasks for each statement.

SS = Start Start = AA
SF = Start Finish = AE
FS = Finish Start = EA
FF = Finish Finish = EE

a. Production can start two days after the supplier has started loading the warehouse.
- SS + 2 days

b. At the end of the last inspection, the recorder can stop his work.
- FF + 0 days

c. The contents of the specifications can only be started once the specifications have been completed. In the project under consideration, however, a new framework document for all future requirement specifications is to be drawn up, the external design of which alone requires 3 days' work.
- FS + 3 days

d. After the screed has been laid on the floor, it must dry for 30 days. Then the plastering of the walls can begin.
- FS + 30 days

e. A company decides to place each new product launch under the supervision of a quality engineer. The quality engineer ordered some equipment to perform product inspections which require 3 months to be delivered.

- SF + 3 months

Task 3: Project Management - Project Planning

An excerpt from a large software project is as follows:

> After the acceptance of the requirement specification has taken place (punctual event!), three developers begin with the work. One of them sets up a working environment for GUI development (estimated effort 35 hours). After he is finished, he starts coding the GUI (effort 140h). After that he begins performing the module test (effort 105h). The other two developers share the coding of the database access functions (since these are many small functions and both have about the same experience, the division is to be regarded as symmetrical; unlike their GUI colleagues, the two do not need to do any preparatory work either). For all the coding process, an effort of 350h had been estimated. When the developers are finished with coding, they perform the module test, which can also be estimated to take 350 hours. Only when all module tests have been completed, a tester starts the integration test, which takes 280 hours.

The following basic conditions apply:

40h week, 5 working days per week, failure caused by secondary employment and absence 12.5%.

a. Enter the duration of all the operations (work packages) in workdays and calendar weeks.

- Actual working hours in a day: 8 – (8*12.5%) = 7h
- Actual working hours in a week: 40 – (40*12.5%) = 35h
- Tasks:

i. GUI environment settings: 35h -> 35/7 = 5 days
35/35 = 1 weeks

ii. GUI Coding: 140h
140h -> 140/7 = 20 days
140/35 = 4 weeks

iii. GUI Test: 105h
105h -> 105/7 = 15 days
105/35 = 3 weeks

iv. Database Coding:
350h -> (350/7) / 2 = 50 days / 2 = 25 days
(350/35) / 2 = 10 weeks / 2 = 5 weeks

v. Module Test:
350h -> (350/7) / 2 = 50 days / 2 = 25 days
(350/35) / 2 = 10 weeks / 2 = 5 weeks

vi. Integration Test:
280h -> 280/7 = 40 days
280/35 = 8 weeks

b. All the activities mentioned shall be plotted on a Gantt chart. Show the dependencies between the activities as arrows. *Note: On paper a true-to-scale representation with exclusive consideration of working days is expected. We assume that the project starts on 1/7/2019.*

c. Mark the critical path in color. Draw the buffer times of the non-critical paths.

d. The programmer of the GUI breaks his leg and is hospitalized for three weeks. Which is the critical path now? By how many calendar weeks does the end of the entire project shift if no personnel replanning is possible?

(Note: In a short-term project schedule, it cannot realistically be assumed that such failures have already been "compensated" by the 12.5% statistical downtime mentioned above!)

Task 4: Effort Calculation

As a project manager, you should plan the next steps of an ongoing software project and allocate resources. This involves design, implementation and module testing in the areas of GUI, application logic (AL) and data base (DB).

The following times in net employee hours were estimated for the respective work packages:

	Design	Implementation	Testing
GUI	120	240	80
AL	80	320	40
DB	40	80	40

As is increasingly common in the software industry, your company works 10 hours a day from Monday to Friday. For meetings and other work 20% of the working time is lost. During the project there is a holiday ban and the sickness rate is so low that you don't have to take it into account. Calculate the gross expenditure per work package in employee weeks and briefly explain how you arrive at your result.

- Normal week has 5*10 = 50h
- Actual working week hours are 50*80% = 40h

	Design	Implementation	Testing
GUI	120 / 40 = 3	240 / 40 = 6	80 / 40 = 2
AL	80 / 40 = 2	320 / 40 = 8	40 / 40 = 1
DB	40 / 40 = 1	80 / 40 = 2	40 / 40 = 1