CSE344/Spring 2020 Software Engineering Student Name:_____
B. Tümer/B. Altınel FINAL EXAM Student Number:_____

1. This exam includes 10 questions.
2. Time for this exam is **100 minutes**.
3. Do not forget to **write down your name and number on each page**.
4. Each question is worth as many points as denoted and distributed at its top.
5. This is an **open-book, open-notes exam**.
6. Please answer the questions in empty spaces left below or aside the questions.
7. ***Use of internet or any communication with anyone throughout the exam are NOT allowed!***
8. You may get partial points. **Work neatly and show all your work**.
9. ***Upload the signed statement of righteousness and solutions in a single pdf file (name_surname.pdf)!!!***
10. Your **handwritten solutions** may be either on the printed exam papers I uploaded or on empty A4 sheets.
11. **Make sure that your answers are readable and the signed statement of righteousness is there!!!**

Good luck!!! ☺

SIGN THE STATEMENT OF RIGHTEOUSNESS BELOW!!!

Karadut

Karadutum, çatal karam, çingenem
Nar tanem, nur tanem, bir tanem.
Ağaç isem dalımsın salkım saçak
Petek isem balımsın ağulum
Günahımsın, vebalimsin.

Dili mercan, dizi mercan, dişi mercan
Yoluna bir can koyduğum
Gökte ararken yerde olduğum.
Karadutum, çatal karam, çingenem
Daha nem olacaktın bir tanem.
Gülen ayvam, ağlayan narımsın.
Kadınım, kısrağım karımsın.

Bedri Rahmi Eyuboğlu

Saklambaç

Geminin yarısından çoğu
Suyun içinde gizli.
Ağacın kökleri toprağın içinde
Boyundan büyük!!!... Gizli!...
Geceler gündüzlerden uzun
Karanlık... Zifiri... Gizli!...
Sır tutan kişi namuslu
Namuslu kişi..... Gizli!...
Alan gizli... Veren gizli...

Desene saklambaç oynamağa gelmişiz
bu dünyaya!!!

Bedri Rahmi Eyuboğlu

Vatan İçin…….

Neler yapmadık şu vatan için!
Kimimiz öldük;
Kimimiz nutuk söyledik.

Orhan Veli Kanık

Hay Kay……..

Yosun kokusu
Ve bir tabak karides
Sandıkburnu'nda

Orhan Veli Kanık

Gemliğe doğru
Denizi göreceksin;
Sakın şaşırma!

Orhan Veli Kanık

Anadolu

Beşikler vermişim Nuh'a,
Salıncaklar, hamaklar;
Havva Anan dünkü çocuk sayılır,
Anadoluyum ben.
Tanıyor musun?

Ahmed Arif

Geçme namert köprüsünden,
Ko aparsın su seni.
Yatma tilki gölgesinde,
Ko yesin aslan seni.

Diyarbakırlı Sait Paşa

Statement of righteousness:

I hereby pledge that I have answered the questions in this exam based only upon my own knowledge, with no communication with any classmate or anyone else, no help from internet or else any other source whatsoever but the lecture notes and the textbooks I was allowed to use; that I did never violate any of the above rules of the exam or take any other inappropriate action that will require any disciplinary precaution.

Name: **Signature:**

Q1. (15+5+10+10+15+15 = 70pts)
Consider the following Deletemin() function in binary heaps. The numbers at the left hand side specify each a ***node*** (i.e., a control node or a regular node) in the ***control flow graph***.

```
ElmntType DeleteMin(PrQ h)
{
        …       // variable declaration section
  1.  if isEmpty(h) {
  2.    display("queue empty"); return (h->elements[0]);
      }
  3.  minelm=h->elements[1]; lastelm=h->elements[h->size--];
  4.  for (i=1; i * 2 <= h->size; i=chld) {
            // find smaller child
  5.    chld=i*2;
  6.    if (chld != h->size && h->elements[chld+1] < h->elements[chld])
  7.        chld++;
            // percolate one level
  8.    if ( lastelm > h->elements[chld] )
  9.        h->elements[i] = h->elements[chld];
  10.   else break;
      }
  11. h->elements[i] =lastelm;
            // restore min-heap property if violated
  12. for (j = i; h->elements[j/2] > lastelm; j/=2 )
  13.   h->elements[j] = h->elements[j/2];
  14. h->elements[j] = lastelm; return minelm;
}
```

a) (15 pts)
Draw the control flow graph of the algorithm above! Your graph may contain only 14 nodes and the B and E nodes to denote the "begin" and "end" of the flow. Please use the numbers to mark the nodes (NOT the code!!!) in the flow graph!

b) (5 pts)
Calculate the computational complexity (CC) of the flow graph!

c) (10 pts)
List ***all*** independent paths!

d) (10 pts)
What independent paths are the following dependent paths composed of?
1. B 1 3 4 5 6 7 8 10 11 12 11 13 14 E
2. B 1 3 4 5 6 7 8 9 4 10 11 12 11 13 14 E

e) (5 + 5 + 5 = 15 pts)
What is the ***statement coverage*** for **each** of the following test cases?
1. elements[1,…,8] ← {11, 21, 16, 31, 41, 61, 71, 51}
2. elements ← empty;
3. both of the **two** above cases together;

f) (5 + 5 + 5 = 15 pts)
What is the ***edge coverage*** for the three cases above in part (e)?

Q2. (10 + 10 = 20 pts)
Consider the following component of a printer driver! This piece of code controls the printing mode of the printer. It is responsible for the assignment of required values to the relevant parameters for corresponding printing modes. In text printing mode, the printer is required to print out documents in at most 4 seconds using 50 units of ink. The printer prints photographs in 60 seconds using 5000 units of ink

```
...
  if ( TextMode() ) {      // text printing mode
    inkLevel = 50;
    printPeriod = 4;
  } else {                 // photography printing mode
    inkLevel = 5000;
    printPeriod = 60;
  }
  ...
  if ( resetPressed() )    // reset button pressed
    printPeriod = 4;
...
```

a) (10pts)
Explain the bug in this code with a **two/three-sentence** discussion!

b) (10pts)
Given the fact that `TextMode()` and `resetPressed()` are two boolean functions, propose a test case involving these functions (for what values of these functions) that would detect the bug!

Q3. (10 + 10 + 10 = 30pts)

MIND Corporation with ***CMM process maturity level 3*** got hired for a project in the sector of intelligent software for autonomous tools used in military and defense systems where MIND is ***one of the sector's best*** with its high quality products. The team of developers consists mostly of *newly hired SW engineers who do not know each other* (***neither bad nor good relations***). Customer company ***set the general goals in the project with only a few critical requirements*** since MIND is very well known in this sector and ***allowed in the project time for a detailed risk analysis which makes the project not vulnerable to risks***.

The ***calendar time estimated for this project*** *has been two years (24 months)* and the ***average*** values of

- five personnel attributes are 0.667 and one personnel attribute is 1,
- three computer multipliers are 1.25,
- five product multipliers are 1.5, and
- three project multipliers are 0.8.

a) (10 pts)
What would you comment on
1. the development and testing team's capabilities; ***(high/low)***
2. the timing requirements and memory constraints; ***(tight/large), (high/low)***
3. the expectations of the customer from the SW system; ***(high/low)***
4. the quality of the SW tools, the development environment, the communication across multiple development sites and the development schedule? ***(high/low)***

Please select your answer from the bolded and italicized choices and write by one sentence why this is your comment.

b) (10 pts)
At the end, the SW system amounted to ***110 KSLOC***. What is the actual effort in PM? Show all your calculations to receive a full point!

c) (10 pts)
What is the percentage error between the actual and estimated development time? Show all your calculations to receive a full point!

Hints:

$PM = A * Size^{B} * M;$ version for post architectural level

$TDEV = 3 * PM^{0.33+0.2*(B-1.01)}$

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Figure 26.9 Scale factors used in the COCOMO II exponent computation

Scale factor	Explanation
Precedentedness	Reflects the previous experience of the organisation with this type of project. Very low means no previous experience; Extra high means that the organisation is completely familiar with this application domain.
Development flexibility	Reflects the degree of flexibility in the development process. Very low means a prescribed process is used; Extra high means that the client sets only general goals.
Architecture/risk resolution	Reflects the extent of risk analysis carried out. Very low means little analysis; Extra high means a complete and thorough risk analysis.
Team cohesion	Reflects how well the development team know each other and work together. Very low means very difficult interactions; Extra high means an integrated and effective team with no communication problems.
Process maturity	Reflects the process maturity of the organisation. The computation of this value depends on the CMM Maturity Questionnaire, but an estimate can be achieved by subtracting the CMM process maturity level from 5.

(***Fill in the blanks questions***)

Q4. (5 pts)
Anomaly detection algorithms are often evaluated by how fast they detect an anomaly. Considering large amounts of multi-dimensional data being processed, they are designed and implemented giving importance to _____.

Q5. (10 pts)
_____ _____-_____ systems are still sometimes programmed in assembly language so that the tight deadlines can be fulfilled since the operations of these systems are considered incorrect if the results they produce fail to meet these time constraints. (**two words, second word has two components**)

Q6. (5 pts)
The idea of a _____-_____ system is to create systems that are intrinsically safe, minimize hazards, control hazards, and reduce the impact of hazards. (**one word with two components**)

Q7. (10 pts)
While at its logical communication level the _____ allows exchange of data and control information among objects on different computers, at the component level it provides a basis for developing compatible components.

Q8. (5 pts)
In _____ _____, requirements are expressed as user scenarios that are directly implemented as a series of tasks where programmers work in pairs and a customer representative takes part in the development and is responsible for defining acceptance tests for the system. (**two words**)

Q9. (10 pts)
Reliability of the software being developed is limited by the _____ reliable tool being used.

Q10. (10 pts)
It is very difficult for a new developer to maintain unreadable code. Thus, _____ is directly proportional to _____. (**two words**)