Ph.D. Comprehensive Examination

Computer Science Department
University of Miami

January 14, 2022

Student Name: Hao Zhu Student Number: C12203432

Problem number	Points (10 max)
1	
2	
3	
Total:	

1. **I.D Software engineering**

From the software engineering point of view, any software development process can be divided into several sub-disciplines:

(a) Requirement Analysis
(b) Functional Specification
(c) Architectural Design
(d) Implementation
(e) Testing and Evaluation
(f) Maintenance

Choose three sub-disciplines or tasks within these sub-disciplines that involve a mathematical approach, and illustrative them with examples.

(a. Requirement Analysis: software
If a person want to build an system, he need to talk to the software development firm. For example, if a client wants to build a banking online website. He first need to send his requirement to the software development group. Usally, the group contains four main members. Project meneger, Architector, Bussiness Analyst, and quality lead.
The Architector knows the ~~th~~ technical functionality. The client can sent his requirements to him, and the architator knows if it is possible to add this functions in the real system.
The But, the ~~bus~~ architecter don't know the banking problem. So, the bussiness analyst will tell the architecter the real bussiness methods about the banking domain.
The quality leads will confirm the quality of the client's requirement is fullfilled well.
And the project manager will manage how to use the resource and the budget, and send the timeline.

After several meeting with the firm of software development, the firm will provid a documents based on the client. It called Software Requirement sepcification (SRS). It will fullfill the return of investment for the client in bank.

ROI = Reduce cost + Custom convinese + increse production enviroment + precision data.

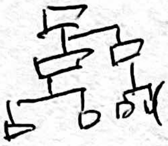
~~Return~~ The SRS will contains scope of software use and sechdule timelines

(C). Architecture design. ~~To~~ In our case, a website needs multiple web servers and databases. The architeur needs to design the system first. This system should allow the website with stand ~~client~~ 1000 Custumor ~~sim~~ visit the website in a same time without the website going down or the performance degrade. ~~And also~~. Then, there may have several linked modules, the architecar needs to let them worked well together. For exemple, ~~each page~~ the websit of online banking have home page, bank belance page, billing page, and self profile pages. They are related, the custemar should can enter the othe page from the home page. ~~This kind of desi~~ Each page is a module. How to connect each module is called High-Level design (HLD). For each module, usally a program team will work on for it. To fullfill ~~the~~ functions in the module, ~~the~~ each team need to create the algorithim ~~data~~ flow chart, data flow diagrm, etc. This work called Low-level-design (LLD). At ~~the~~ each design section Cycle, ~~the programer and~~ the group need to write the documente. The architecar need to review the SRS, HLD documets, and LLD documets. Sometimes, ~~also~~ it also need to be checked with the program experts to make sure of them..

(d.) Implemeres. After the review of the LLD documents. The programer team can start to write the source code. While finish writing the code. The programmers also need to check the coding efficiency, coding standard, or if there has dead code or none use classes. ~~To~~ This also called unit testing. After the unit testing, the program will send to the test group to do the further testing.

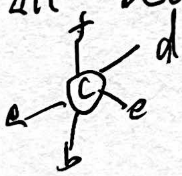
2. **I.E Systems**

Compare and contrast (*i*) hierarchical, (*ii*) network, (*iii*) the relational, and (*iv*) object-oriented data models.



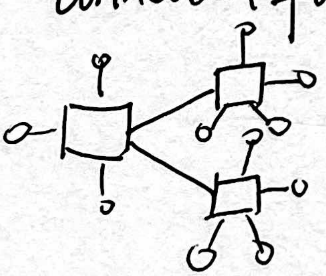
(1). hierarchical date model is from up to down ~~model~~ date restorem.
For example, a department members should start from the leader of the department and put this on the first ~~step~~ class, the other related like HR section, maneger section, or cleaning secton leader should at the second class, they are leeded by the whole leader. ~~and~~ so connected to the first class. Then the ~~workers~~ belongs to the HR section should at the third ~~seat~~ class related to the respectic second class and the other workers of its section are as the same rule. This model is easy to find the belongs-relationship from each class. But is compliex to estbish the pertenes and kids.

(2). network date model.
for the ~~node~~ nodes in the graph that ~~have~~ can get connected. If ~~two nodes~~ nodes, a and b, ~~have~~ eated ~~connected pare are at have a feature~~, are all belongs to C, we can build a network model like following



If we want to search ~~are~~ the nodes belongs to C, its easy and fast to should the resules.

(3). relational date model. ~~like network model~~ Get fully connected for all the connections between differenc classes, like,



the rocket crew should releted to shuffle and NASA sciteist, and some of them also ~~share~~ in both of two crews. this reletional date will find ~~the~~ people who have more then one titles. ~~D~~ ~~Io~~ However, Complex it is ~~had~~ to ~~get related of each~~ build the relation

(4). object- oriented date model.

list all the lebel for each individel ~~x~~. ~~in the~~

if ~~have~~ it has the lebel, push(1), ~~a~~ hasn't, set (0).

while serching, ~~the feat~~ just give the resulte that

the feature = (1). Its very simple to get the

resultes, may increase the save space.

A{2,5,4,1,3}
P(A){1,2,3,4,5}

Student Name: Hao Zhu Ph.D. Comprehensive Examination

r=3, P(3) = {1,2,3} = {2,3,4}

3. **III.C Discrete Structures**

A **permutation** of a set A is an *ordered* arrangement of the elements in A. An ordered arrangement of just r elements from A is called an r-permutation of A. For non-negative integers $r \leq n$, $P(n,r)$ denotes the number of r-permutations of a set with n elements.

What is $P(n,r)$? This is about counting.

For example, if Aset = {2,3,1}

permutation A = {1,2,3}

if r=2,

r-permutation A = {1,2,} {1,3} {2,3}

number of 2-permutation of A's $P(2,3) = C_3^2 = 3$

Back to this case, permutation set N (N sets has n numbers)

r-permutation N = {1,...,r} {1,...,} = { }

∵ P(n,r) denotes the number,

∴ P(n,r) = C_n^r