Software Engineering (Adv CS II, 320212)

Final Exam Spring 2013

Logistics

- You have 90 minutes (sharp) for the test.
- You can reach 68 points if you solve all problems. You will only need 64 points for a perfect score, i.e. 4 points are bonus points.
- Mark all sheets you deliver with your name to make sure it can get graded. We cannot grade if not present or illegible!
- *Different problems test different skills and knowledge, so do not get stuck on one problem.*

Name:

(To be used for correcting, do not write into box below)

Task	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.3	4.1	**Total**
Total	4.5	4	5.5	6	4	4	4	3	5	**40**
Reached										

Task	4.2	4.3	5.1	5.2	5.3	5.4	6.1	6.2	6.3	**Total**
Total	4	3	4	3	3	3	1	3	4	**28**
Reached										

1 Graphical User Interface Technology

Task 1.1 (3x1.5p): List the three technological concepts of modern GUI systems; for each one, provide a detailed description.

Answer:
0.5 for name, 1 for desctiption.

1.5p Event-driven programming: Programming where the communication from user to computer is done via events, which goes to a single event queue provided by the operating system. Allows to make the system wait for the user

1.5p Widgets: Reusable interactive object responsible for handling certain events, updating its appearance, and generating new events and sending them to listeners. These are the basic elements of the interface

1.5p Interactor Tree: Decomposition of widgets into a tree structure, typically modeled through inheritance or parent-child relations. Allows identification of where to send events.

Task 1.2 (4x1p): Define the Model-View-Controller architecture and describe its main components.

Answer:

1p MVC is an architecture for interactive applications, which partitions the app with respect to scalability and maintainability.

1p Model: Information the app is manipulating/processing, typically a representation of some data/objects.

1p View: Implementation of a/many visual/acoustic representation(s) of the model.

1p Controller: Component used to manage all input events and takes decision based on a previously defined logic.

Task 1.3 (1.5+2+2p): Jacobs University Bremen introduced a new policy regarding teaching evaluations. These are now mandatory and you are required to extend campusNet by means of a new web application which manages these evaluations online. Design a simple system based on the MVC architecture, which supports the following specifications:

(1) The user can select a course to be evaluated.
(2) In case only 3 days remain until the semester ends and the user has not evaluated a course, that course should be highlighted.
(3) If a student has not completed a course evaluation, he cannot pass the course.
(4) The user should be able to save an evaluation at any time.
(5) After submitting the evaluation, the course disappears from the "to-do" list.

For each requirement, sketch or describe a feature fulfilling it and assign it to M/V/C, respectively.

Exemplary Answer: (This task requires creativity and any plausible answer will receive full points)

1.5 Model: - Courses, Evaluations data, etc.

2 Views: - Display a list of to-be-evaluated courses. (Courses that have an

approaching

deadline, i.e. less than 3 days, would be colored in red to address importance)

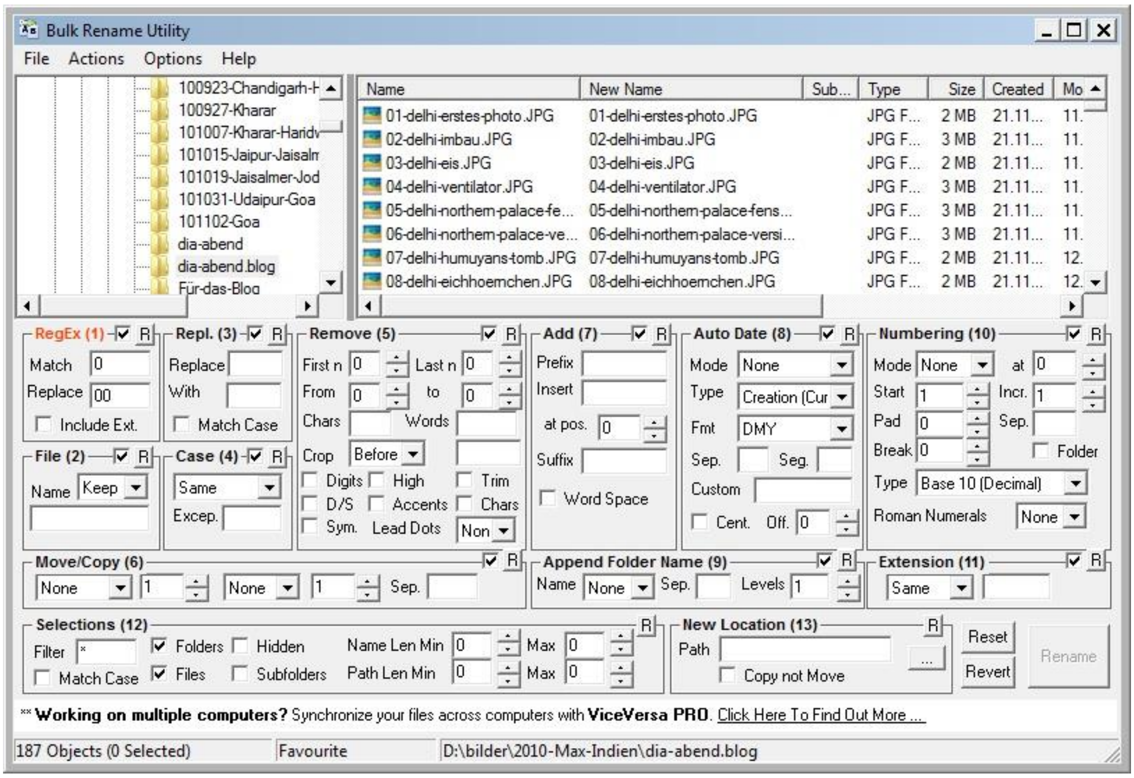
- Display progress of each evaluation (percentage of the completed evaluation)
- Notify the user in the campusNet homepage in case only few days are left
- Admin area: Display of completed and not yet completed evaluations from all students

2 Controller:

- Automatically fill the "to-do" list according to the courses taken by the student
- Set the grade in the academic results section to "fail" if a student has not completed an evaluation
- Provide the functionality to save an evaluation and to continue it from the last state
- Notify the View and Model about the current progress of an evaluation

2 User Interface Design

Task 2.1 (4x1.5p): List the three golden rules described by Pressman. Consider the following 3 screenshots of UI designs and state where those rules clearly apply and where they are certainly violated. Justify your answer.



100923-Chandigarh-H
100927-Kharar
101007-Kharar-Haridv
101015-Jaipur-Jaisalm
101019-Jaisalmer-Jod
101031-Udaipur-Goa
101102-Goa
dia-abend
dia-abend.blog
Für-das-Blog

Name	New Name	Sub...	Type	Size	Created	Mo
01-delhi-erstes-photo.JPG	01-delhi-erstes-photo.JPG		JPG F...	2 MB	21.11...	11.
02-delhi-imbau.JPG	02-delhi-imbau.JPG		JPG F...	3 MB	21.11...	11.
03-delhi-eis.JPG	03-delhi-eis.JPG		JPG F...	2 MB	21.11...	11.
04-delhi-ventilator.JPG	04-delhi-ventilator.JPG		JPG F...	3 MB	21.11...	11.
05-delhi-northem-palace-fe...	05-delhi-northem-palace-fens...		JPG F...	3 MB	21.11...	11.
06-delhi-northem-palace-ve...	06-delhi-northem-palace-versi...		JPG F...	3 MB	21.11...	11.
07-delhi-humuyans-tomb.JPG	07-delhi-humuyans-tomb.JPG		JPG F...	2 MB	21.11...	12.
08-delhi-eichhoemchen.JPG	08-delhi-eichhoemchen.JPG		JPG F...	2 MB	21.11...	12.

RegEx (1) ☑ R — Match 0; Replace 00; ☐ Include Ext.

Repl. (3) ☑ R — Replace; With; ☐ Match Case

Remove (5) ☑ R — First n 0; Last n 0; From 0; to 0; Chars; Words; Crop Before; ☐ Digits ☐ High ☐ Trim; ☐ D/S ☐ Accents ☐ Chars; ☐ Sym. Lead Dots Non

Add (7) ☑ R — Prefix; Insert; at pos. 0; Suffix; ☐ Word Space

Auto Date (8) ☑ R — Mode None; Type Creation (Cur; Fmt DMY; Sep.; Seg.; Custom; ☐ Cent. Off. 0

Numbering (10) ☑ R — Mode None; at 0; Start 1; Incr. 1; Pad 0; Sep.; Break 0; ☐ Folder; Type Base 10 (Decimal); Roman Numerals None

File (2) ☑ R — Name Keep

Case (4) ☑ R — Same; Excep.

Move/Copy (6) ☑ R — None 1 None 1 Sep.

Append Folder Name (9) ☑ R — Name None; Sep.; Levels 1

Extension (11) ☑ R — Same

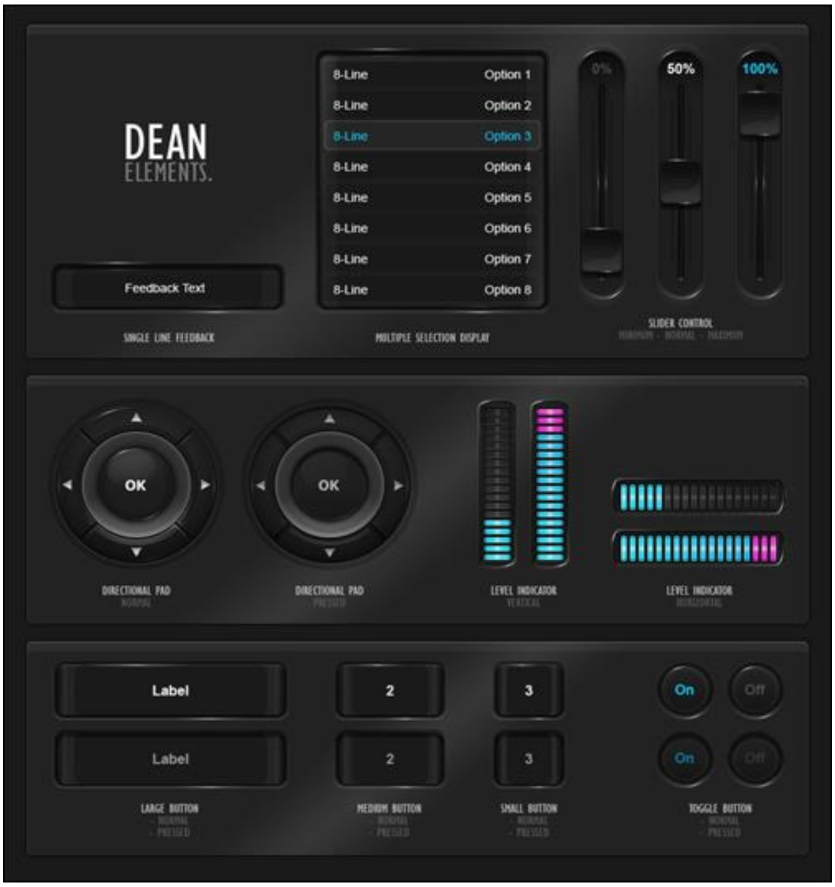
Selections (12) R — Filter *; ☑ Folders ☐ Hidden; ☐ Match Case ☑ Files ☐ Subfolders; Name Len Min 0 Max 0; Path Len Min 0 Max 0

New Location (13) R — Path; ☐ Copy not Move

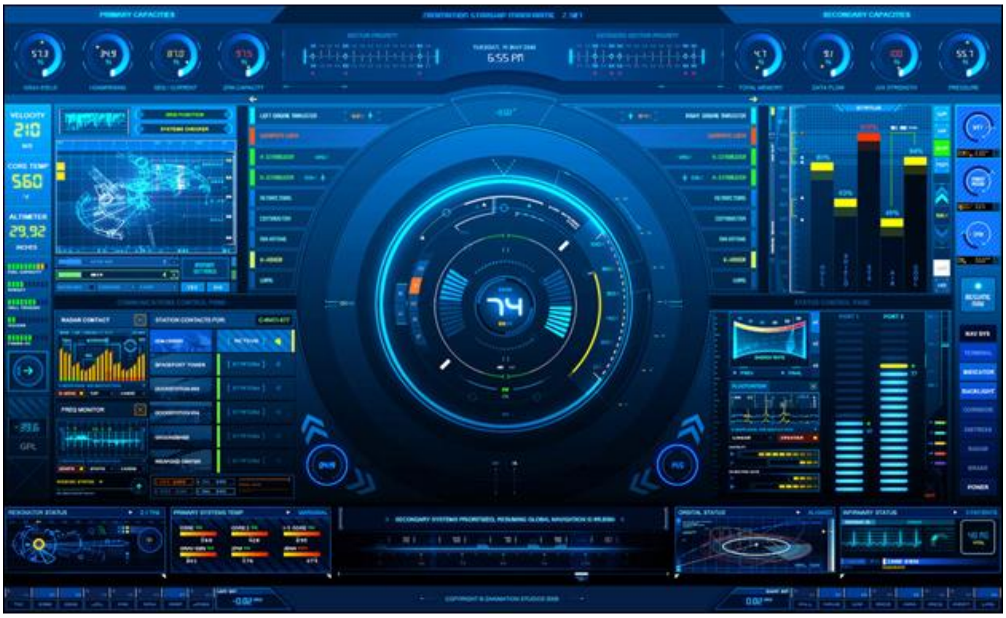
** **Working on multiple computers?** Synchronize your files across computers with **ViceVersa PRO**. Click Here To Find Out More ...

187 Objects (0 Selected) | Favourite | D:\bilder\2010-Max-Indien\dia-abend.blog

#1



#2



#3

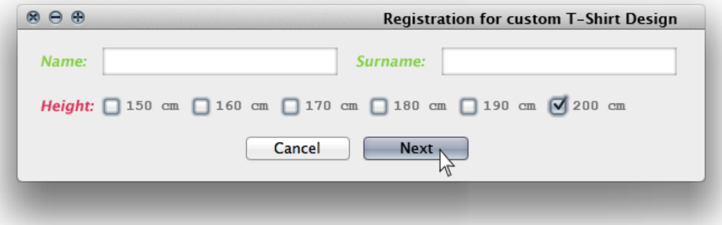
Answer (any plausible analysis will get at least half points, correct ones full points):

#1 Violated: reduce user's memory load, somewhat inconsistent (too crammed with content of different kinds) -> bad UI

#2 fulfills all rules -> good UI

#3 does not reduce the user's memory load but appealing, consistent UI -> appealing UI but requires some improvement | not intuitive

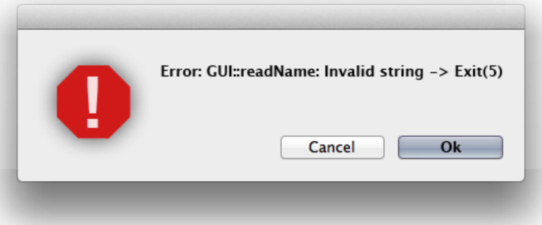
Task 2.2 (4p): Given the following two windows, indicate where the UI designer made mistakes and redesign the interface by specifying 4 design fixes that take into account good UI design principles. Note that the lower window is a response triggered after the user has clicked "Next" on the upper window.



Registration for custom T-Shirt Design

Name: Surname:

Height: □ 150 cm □ 160 cm □ 170 cm □ 180 cm □ 190 cm ☑ 200 cm



Error: GUI::readName: Invalid string -> Exit(5)

Answer:

1p Inconsistent use of fonts, and text alignments -> Make them consistent

1p A system error occurred for two empty strings -> A warning should occur or the "next" button should be unclickable

1p Only discrete height values can be chosen -> Either use a scroll bar or a text field

1p Provide a navigation bar to see the progress

Task 2.3 (4p):

Ethnography is an analysis technique used for *gathering user interface requirements*; describe what the technique consists of and elaborate on which advantages it provides with respect to using questionnaires. Finally elaborate on costs of the technique.

Answer: It consists of observing users at work in their current environment (where the UI is not yet available). It can highlight behavior that is intuitively done or so “natural/obvious” that would not be answered with a questionnaire. It is more costly than the other technique since it requires an engineer to be sent to the client site for doing the observations.

3 Web Content Management Systems

Task 3.1 (2x2p): Explain the difference(s) between a hard-coded business logic and a configured business logic based on a 3-tier architecture. Elaborate on the difference if a new law requires having a disclaimer on each page where safety related content is displayed.

Answer:
Configured is characterized by the presence of a database of business rules (in the data tier) and a generator that creates pages according to these rules (hard coded has business logic coded only in the middle tier)
Addressing the new rule with a configured logic is simpler since it requires just adding the proper rule, in hardcoded the middle tier code has to be changed (for each page).
(cf. slide set 32 number 5)

Task 3.2 (2x1.5p): Testing a Web Application is different from testing a Desktop application. Give 2 examples (hint: consider network bandwidth, concurrency, automation,…).
Answer: (cf. slide set 32 number 14) TO BE CHANGED

0.5p Network intensiveness
0.5p Concurrency
0.5p Performance
0.5p Availability
0.5p Content sensitive

4 Language Processing

Task 4.1 (1+2+2 pts) Write a bison code that evaluates Boolean expressions, supporting the following 3 rules"

- 'and' ('a'), 'or' ('o'), 'not' ('n').

You can expect the input number to be boolean, i.e. no check for correct input is needed. Your grammar should also handle nested expressions denoted with brackets. Here are some example inputs:

```
1 a 0                    (should return 0)
1 o (1 a 0)              (should return 1)
```

Answer: (1p for the general layout, 2p for (1), 2p for brackets)

```
%token BOOL
%%
input:      exp             { $$ = S1; }
;

exp:        BOOL              { $$ = $1; }
          | exp 'a' exp       { $$ = $1 && $3; }
          | exp 'o' exp       { $$ = $1 || $3; }
          | 'n' exp           { $$ = !$2; }
```

```
            | '(' exp ')'            { $$ = $2; }
;
%%
```

Task 4.2 (2x2p) Name and briefly describe the two principal internal data structures a compiler (like g++) maintains with respect to language processing.

Answer:

Symbol table: hold information about name of entities used in the text being translated

Syntax tree: internal structure representing the program being compiled

Name 1 p (just table and tree identification half points), description 1p

Task 4.3 (3x1p): You are writing a compiler for a nice new language you invented. Given the overall organization into Frontend, Optimizer and Backend, describe which main functions of the compiler belong to each component.

Answer:

Frontend: At least lexical and syntactic analysis (parsing)

Optimizer: translation of the syntax tree into a more efficient representation, semantic analysis

Backend: At least code generation

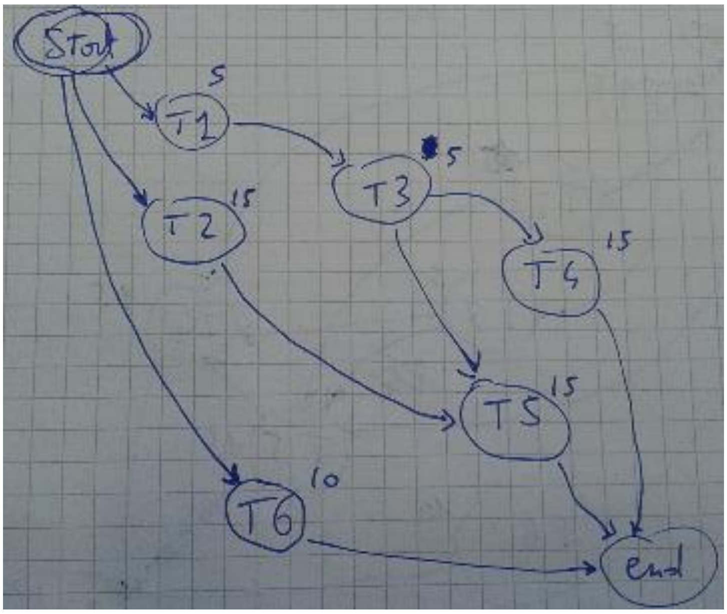
(cf. slide set 31 number 6)

5. Software Process and Project Management

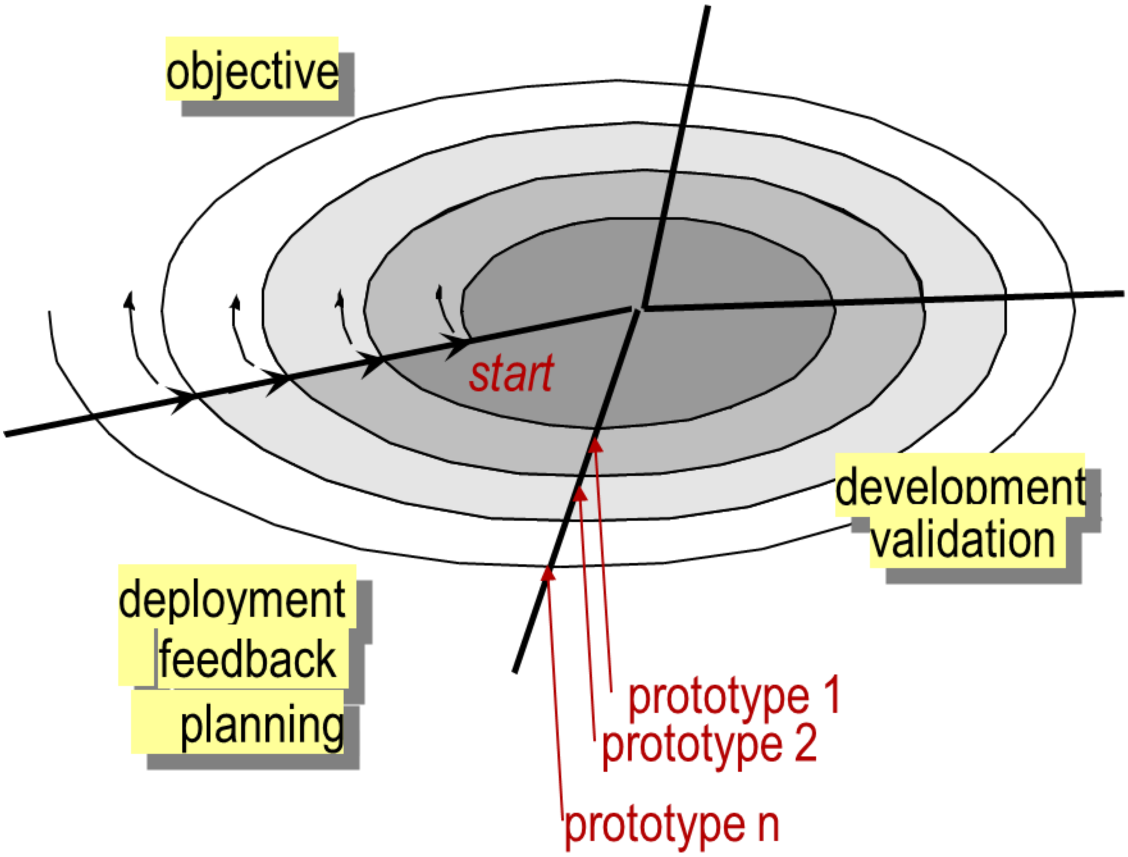
Task 5.1 (4p): Build a PERT chart from the table content given below (hint: you can leave out milestones and link tasks directly). Provide a definition of the "critical path" and identify it on your PERT chart enclosing it in a dashed line (- - - - - -) or listing the tasks on it.

Task	**Duration (days)**	**Dependencies**
T1	5	
T2	15	
T3	5	T1
T4	15	T3
T5	15	T2, T3
T6	10	

Answer: 2.5 for correct chart (even without milestones) but must include durations (for critical path identification) and correct dependencies. Critical path is the longest (in term of duration) from start to end. (1 for correct definition) + 0.5 (correct path identification: T2,T5).



Task 5.2 (3x2p): Based on the graphical representation of the spiral model below. There is one missing key sector in this diagram that differentiates this model from the other process models. Name it, explain it, and elaborate by a concrete example



Risk assessment & reduction: (anything related to risk gives 2 points)

(1) Risks assessed (Rate by probability and effect) 1+1
(2) Activities to reduce top rated risks (and catastrophic effect ones) 1+1(if example provided)

Task 5.3 (3x1p): Give a definition of extreme programming and explain advantages and disadvantages with respect to software quality and user involvement.

Answer: (1 point for definition, 1 point for correct listing, 1 point for detailed explanation)

1p XP is a variation of iterative development based on very small increments. New versions may be built several times a day, increments are delivered to the customer every ~ 2 weeks, and all tests must be run for every build.

1p Advantages: XP delivers cheaper software, compared to other models, which is likely to do do exactly the customer wants. It also creates working software faster, and that software tends to have very few defects.

1p Disadvantages: It's difficult to get many developers to accept the practices, and it takes a lot of discipline to keep doing them all. Customers may not like the idea of having to be so involved.

Task 5.4 (3p): Based on the classification given in Kal Toth's paper "Which is the Right Software Process for Your Problem?", name the two best suited process models to develop a software system where requirements are expressed by an unexperienced analyst in a few pages with little input from the user. Base your selection only on "Requirements Uncertainty" and explain your choice accordingly.

From the paper, requirements as above are classified as "highly uncertain", best models are evolutionary (addresses with throw away prototyping uncertain requirements) and Agile/XP (allows fast refinement of the requirements as they are better understood). Both rely on high user involvement to get feedback on and refine requirements.
0.5 points for each correct choice. 1 point for each complete and clear explanation.

6. CMMI

Task 6.1 (1p): What is Capability Maturity Model Integration (CMMI)?
Answer: CMMI is a model used to assess the capabilities of organizations to manage their IT processes.

Task 6.2 (3p): Read the following description of a company and draw a process capability profile with respect to risk, configuration, and requirement management.

Since 2011 'Nanosoft Corporation' focuses on personalized software in the field of finance modeling and accounting. Their core development environment consists of the in-house software AccV2.0, which also provides the core functionality for all the clients. I.e. every client has the current release of this software and additional, personalized modules, developed at Nanosoft and currently shipped through a secure internet connection. All releases are tracked into a database with customer details included. This software has been developed and constantly improved over the past nine years. Despite the current lack of control and project management in the personalized sector, where requirements are informally gathered as need arise, a top priority for Nanosoft is formed by project management procedures set out for risk management in order to avoid undesired behavior of the software.

Answer:
Risk management: repeatable (2)
Configuration management: managed (4)
Requirement management: initial (1)
1p “correct diagram type”, 1p reasonable consistent values (relative grade of profiled properties is consistent), 1p exact values (+/- 2 overall)

Task 6.3 (4p): In this course, two cases have been discussed where the Ada construct "pragma suppress" has caused a catastrophe. What are the technical reasons in each case, and why was the root cause not prevented upfront by management? **Relate both cases to the term "software quality".**

Answer:
1+1 - The two cases were Ariane 5 (overflow) and the solar power plant (array index out of bounds).
1 - In both cases the issues were not detected due to the use of the Pragma suppress directive which disables runtime checks
1 - Management should have invested more money for bigger computers, so that we can run these checks. Stability and reliability are integral part of the software quality.