Name: _____   **Student ID Number:** _____

Signature: _____

CPSC 444 2002-'03 (T1) Final Exam

Department of Computer Science
University of British Columbia
K. MacLean

Exam Instructions (read carefully):

1. Sign the first page of the exam with your **signature** in the space provided on the upper left **immediately**.

2. Continue reading the instructions, but **do not open the exam booklet** until you are told to do so by a proctor.

3. Cheating is an academic offense. Your signature on the exam indicates that you **understand** and **agree to** the University's policies regarding cheating on exams.

4. The exam is **closed book**. There are **no aids permitted**, except for a calculator.

5. No one will be permitted to leave the exam room during the **last ten minutes** of the exam.

Question	Points Possible	Mark
1	16	
2	16	
3	28	
4	27	
5	15	
6	10	
7	18	
8	16	
9	20	
10	18	
11	16	
Total	**200**	

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Peer Review

DO NOT PROCEED BEYOND THIS PAGE UNTIL INSTRUCTED

Read instructions carefully before beginning the peer review:

- Be **objective, fair and honest**.

- Mark each teammate independently; there is no limit to the "marks" you can hand out.

- Four criteria for your marks are provided, including an "overall / other" criteria in which you can either make an overall assessment, or assess an aspect not otherwise mentioned. If you are marking another aspect ("other") please identify it in the space below the table.

- In computing an individual's peer score, criteria will be weighted equally and input from all teammates will be averaged.

- **If you give any mark of -1 or lower, please comment further in the space below the table, identifying the teammate by name.**

- Your responses will be confidential. Each team member will receive their averaged score, plus any comments (typed), with no names attached.

- **You must complete the evaluation.** Blank or incomplete evaluations will be counted against your final exam score.

-2	-1	0	1	2
inadequate	marginal	acceptable	good	excellent

Enter **your team number**, and **each teammate's name** in the left column, **printing clearly**; then **enter a mark of [2 to –2] under each of the criteria** in the remaining four columns for each teammate.

Team number: ___ Teammate name ↓	(a) Positive attitude	(b) Did his/her share of the work in a timely manner	(c) Contributed ideas and/or leadership	(d) Overall / Other (if "other", identify below)

Justify any low marks (-1 or -2). State teammate's name first, and continue on back of this sheet if necessary.

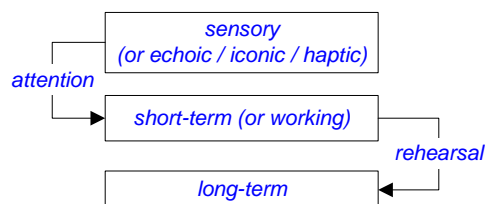## Question #1 [16 points total]: Theories of Human Performance

(a) "Spotlight" and "FINST" are two theories of how ___*attention*___ works.
Describe each, highlighting the difference between the two. [5 pts]

> *The "spotlight" theory of attention is based on a unitary locus of attention that the user controls by scanning through space.*
>
> *The "FINST" theory (Fingers of Instantiation), is based a set number (4-7) of attentional tokens which are "indexed" by having a FINST assigned to them.*
>
> *1 pt for "attention", 2 pts for getting key aspects of each of the theories right.*

(b) Name three principal **types** of human memory, writing them into the 3 boxes below. Name the **mechanisms** by which information moves among the different memory types, and indicate these information pathways using arrows between the boxes. A point will be subtracted for each incorrectly drawn arrow. [11 pts]

```
┌─────────────────────────────┐
│                             │
└─────────────────────────────┘

┌─────────────────────────────┐
│                             │
└─────────────────────────────┘

┌─────────────────────────────┐
│                             │
└─────────────────────────────┘
```

sensory
(or echoic / iconic / haptic)

attention

short-term (or working)

rehearsal

long-term

1 pt for each correctly named type of memory (3 pts), 2 pts for each correctly named mechanism; and correctly drawn arrow (8 pts). Subtract points for an incorrectly drawn arrow.

Question #2 [16 points total]: Communication and Collaboration

Some important social aspects of group problem-solving include

- **proximity and awareness** of the presence, participation and activities of all members of the group;

- **simultaneous access** of all members of the group to artifacts that store information, help to express ideas, or mediate interaction;

- facilitation of **turn-taking**.

> You are designing a system that will support realtime web conferencing among project team members working for a large but geographically distributed company. Users will access the tool from their desktop computers. Due to the remote location of many of the company's offices, streaming video and audio through the computer interface cannot technically be supported, nor is a simultaneous telephony (voice) hookup feasible. Viable candidates for communication include any computer-based communication with relatively low throughput requirements - e.g. text, simple graphics or snapshots and sounds.

(a) List two **kinds** of constraints being imposed on this design. [4 pts]

1. _____*Technological*_____

2. _____*Social*_____

(b) Given these constraints, describe a mechanism by which two of these aspects of group problem solving might be addressed (1-2 sentences each). Address both what the feature is, and how it addresses that aspect of concern. *The first one is completed as an example*. [6 pts per mechanism]

Aspect	Design Mechanism
Proximity / Awareness	*An icon or avatar on the screen represents each remote member of the conference, which moves about or changes state in response to the number of exchanges that individual has made in the last 5 minutes. The icon thus displays some measure of that individual's participation in the conversation.*
Simultaneous access	*E.g. a shared sketchpad is visible in a window to all conference participants. If one user draws on the sketchpad, this information is updated immediately in the view seen by all the others.*
Turn-taking	*E.g., only one member is able to draw on the sketchpad at once. The avatar of the current "sketcher" is highlighted in the other members' view, so they know who is drawing. To request permission to sketch, a non-drawing member clicks on the highlighted icon, and this appears as a blinking avatar in the active sketcher's display. To grant permission to sketch, the active sketcher clicks on the requestor's avatar, thus relinquishing control over the sketch.*

Question #3 [28 points total]: Design Process

You've been given the challenge of designing the web-conferencing system described in the previous question. You need to plan the **process** you will take, to get from the general situation of concern (as stated in previous question) to a fully functional prototype approved by all critical stakeholders. Given the time scale and resources allocated to the task, you decide to take a formative approach.

On the following page, diagram 6-10 steps of a possible design process which encompass the following:

- Include the points at which you propose to include users, a justification for doing so, and how;

- Indicate with arrows where you are likely to iterate on stages in the design, as demonstrated in diagram at right.

- For each step, state the primary activity of that step (e.g. "prototype functional flow" or "evaluate appearance prototype"), AND describe the activity and its objectives in more detail (one sentence).

- For prototyping and evaluation steps, the activity description should include the general type of prototype you would expect to build or the type of study you'd conduct, based on the information you expect to need at that point.
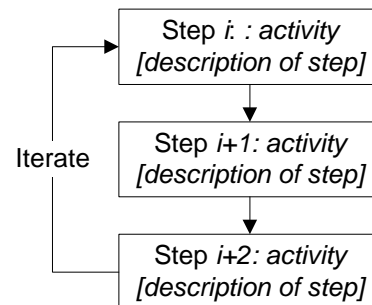
There is no single correct answer to this question, although there are some key steps that should not be omitted. Sequencing and to some degree inclusion can vary (and does, in the real world), depending on constraints and the nature of the problem. Credit will be given for reasonable and well-justified answers; and for completeness of the overall process. [28 pts]

Answer on following page. No credit will be given for marks on this page.

> *Answer should include the following elements:*
>
> - *[4 pts] Near the beginning, some form of pre-design observation and data gathering*
>
> - *[4 pts] Multiple prototyping / evaluation pairs (at least 2), in reference to formative approach*
>
> - *[6 pts] Mention of different and appropriate types of prototypes (e.g. appearance / functional) and evaluation methods (e.g. informal – such as questionnaires, focus groups, interview; observation methods; and formal - controlled.)*
>
> - *[4 pts] Iteration, demonstrated by arrows as above, and probably following the outcome of an evaluation step*
>
> - *[5 pts] Overall completeness*
>
> - *[5 pts] Overall sensibility of approach*

Question #3 (continued)

Diagram your design process on this page.

Question #4 [27 points total]: Evaluation Methods

Below are several scenarios where some type of evaluation is called for. For each, discuss the following in the corresponding boxes below. As usual, there is more than one *good* answer to each part (there are also a lot of not-very-good answers).

1. What is an important, generally stated **experiment question** that urgently needs to be answered? [3 pts each]

2. What *type* **of study or other exposure** would most appropriately address this question? State whether you need formal or informally obtained data, as well as experiment technique chosen from those mentioned in class. Justify your response in 1-2 sentences. [3 pts each]

3. What **kind of prototype, setup or environment** do you need in order to do this study, if any? Describe its key capabilities as well as its ideal user group in 1-2 sentences (*e.g. "Appearance mockup which demonstrates the handheld communicator's overall size, styling and button locations; users are 10-14-year old girls*"). [3 pts each]

Scenario A: You have just been put in charge of a design team in the early stages of developing a concept for an onboard automobile navigation system. The leading approach employs an LCD screen in the center console that shows location obtained through an onboard GPS (global positioning satellite) overlaid on an area map. Technologically, the most feasible candidates for input mechanism seem to be voice, touchscreen and a multi-purpose knob. Your marketing people tell you your target customer is aged 55-70, male and in a middle-income bracket. This is a new demographic for the company, which has always focused on the low-end market. Before you came, the team had never heard of "user-centered design", and Marketing thinks it means keeping current on Car & Driver[1] editorials.	
1.	*Possible good questions: Does the customer want a navigation system? What performance capabilities or limitations therein does this demographic have? What else is the customer doing when driving a car?* *Bad question: What's the difference in performance among the candidates for input mechanism? (we aren't ready for that yet).*
2.	*Types of studies: just about any informal pre-design user study can probably fit some aspect of this need. E.g. ethnographic (although there may not be time for that) contextual inquiry, observation of how drivers use maps in cars now, questionnaire/focus group, even general performance capability.*
3.	*Kinds of prototypes: Some types of study would not need a specially built prototype, however all would benefit from some kind of prop or environment. E.g. a car equipped with a camera in which subjects can be studied while driving and navigating; or an appearance mockup of several initial concepts that would be shown in a focus group to gauge interest.* *Users will be members of the target demographic.*

---

[1] Car & Driver is a popular driving magazine

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Scenario B: You are halfway through the design of a new campus-wide electronic vending machine system at UBC. Users may purchase vending card credits, usable via a magnetic card at any vending machine location, and manage their account online. An earlier survey has demonstrated widespread support among UBC students for this approach, especially if a wider selection of merchandise may be purchased in this way. The detail design of the vending machine interface is well underway, and you've been asked to start on the online part. One of your team members thinks it should include a clickable map of where the machines are located, their current contents and a way to request new contents as well as personal account management. Another is full of ideas about how this system should be linked to students' university Ids and/or copycards. There are many, many other ideas from the team. At this point, you're not sure what functions the online access should include or what it should look like.

1.	*Possible good questions: How much functionality should the online access include? Should it be simple or comprehensive? How much complexity is the user willing to deal with? What functions are most important to the user, and will they be likely to access from a website? Given several alternative design "looks" and layouts, which seem most preferable to the user?*
	Bad question: Any kind of performance-related question, or anything based on a detailed or functional mockup. Not ready for that yet. Also, not interested in what's for sale in the vending machines, or in general support of idea of vending machines and method of payment (have addressed that already in previous survey).
2.	*Types of studies: optimal studies for most of above questions are sitting on border between pre-design familiarization and evaluation of early prototypes. For example, questionnaires, surveys and focus groups; and/or observation while using informal mockups of several design approaches.*
3.	*Kinds of prototypes: needed only for a study that asks for responses to informal mockups (e.g. observation or focus groups). Probably no special setups required. Users should be UBC inhabitants who indicated greatest support on the original surveys (since they're most likely to be using it).*

Scenario C: Your company produces the #1-selling personal financial accounting software in North America. Your main product has over the years become a massive program with a huge number of functions, and a redesign is needed for the next product release (on a tight timeline) to make it easier for novices to use while maintaining the overall functionality for expert users. A large number of approaches have been storyboarded; the design team has merged these into three concrete and quite different design proposals.

1.	*Possible good questions: Which of the three general approaches is going to result in the most usable design for novices, as measured by learnability, errors, number of functions accessible, etc..*
2.	*Types of studies: Depending on details of question, this could be a controlled study, some type of informal approach (e.g. observation while using prototypes, or possibly (not so good) a focus group.*
	Bad answer: CW / HE aren't too good since design team and expert user are not likely to be ideal for simulating novice user behavior.
3.	*Kinds of prototypes: definitely need prototypes here. If a controlled performance study or observation while using, need a functional mockup. Alternatively, an appearance mockup or paper prototype for a focus group, but this is a less preferred approach.*

Question #5 [15 points total]: Modeling User Activity

The "GOMS" method, or keystroke-level analysis, is one way of obtaining an empirically based dynamic model. Given the following task, two action sequences for accomplishing this task, and the empirically derived data provided on the following page, predict the following:

(a) How many seconds (to 1 decimal point accuracy) will each sequence require to execute? Show your work below (next to action sequence description) to get partial credit for an incorrect answer. [8 pts]

Sequence 1: _____*4.36 sec*_____   Sequence 2: _____*4.18 sec*_____

2 pts given for getting Seq 2 > Seq 1; 3 pts per correct value

(b) What is the problem with the slower sequence (i.e., what makes it slower)? [2 pts]

Sequence 1 is slightly slower even though fewer individual keystrokes are required, because it requires an additional mouse movement: at 1.1 seconds, this is a pretty slow operation.

(c) Propose another action sequence that would be faster than either of these. How long will it take? [5 pts]

Points given for any reasonable response; [3 pts for describing a plausible action, 2 pts for giving correct time]. For example: double-click on the whole word then retype it (1P+4B+8K = 1.1+0.4+8x0.28 = 3.74

Task: Rename a file in a File Manager window in a Microsoft Windows desktop. Make the following assumptions for both action sequences:
- One file is to be to be renamed.
- The File Manager window is on top
- File name is visible and can be pointed to
- Original name is "exam2.doc" and new name is "midterm2.doc"
- Hand starts and ends on mouse
- User is average non-professional typist (40 wpm)

Action sequence 1: Select "exam" and then type "midterm". The exact sequence is:

1. place cursor before "e"   *P*
2. press and hold mouse button   *B*
3. drag cursor to after "m"   *P*
4. release mouse button   *B*
5. type "midterm" (7 characters)   *7xK*

*Total time = **2P** + **2B** + **7K**=*

2x1.1 + 2x0.1 + 7x0.28= 4.36 sec

Action sequence 2: Place cursor between "m" and "2", backspace to start of word then type "midterm". The exact sequence is:

1. place icon between "m" and "2"   *P*
2. backspace to start (4x)   *4xK*
3. type "midterm" (7 characters)   *7xK*

*Total time = **1P** + **11K** =*

1x1.1 + 11x0.28 = 4.18 sec

Information for Question #5
NO CREDIT GIVEN FOR ANYTHING WRITTEN ON THIS PAGE.
EXAM CONTINES ON FOLLOWING PAGE.

Empirically derived Operators & Times *– source: Kieras, 1993*

K - Keystroke (.12 - 1.2 sec; 0.28 recommended for most users). This operator is pressing a key or button on the keyboard. Pressing the SHIFT or CONTROL key counts as a separate keystroke. Different experience levels have different times for the K operator:

- Expert typist (90 wpm):   0.12 sec
- Average skilled typist (55 wpm):   0.20 sec
- Average nonprofessional typist (40 wpm):   0.28 sec
- Worst typist (unfamiliar with keyboard):   1.20 sec

T(n) - Type a sequence of *n* characters on a keyboard (n × K sec). This operator is simply a shorthand for a series of K operators, and would normally be used only when the user is typing a string of characters that is a single "chunk," such as a filename.

P - Point with mouse to a target on the display (1.1 sec). This operator represents the action of moving the mouse to point the cursor to a desired place on the screen. The actual time required can be determined from Fitt's law.

B - Press or release mouse button (0.1 sec). This is a highly practiced, very rapid movement. Use 0.1 sec for pushing the button down or letting it up.

BB - Click mouse button (0.2 sec). Pushing and releasing the mouse button rapidly, as in a selection click, counts as two B operators, for a total of 0.2 sec.

H - Home hands to keyboard or mouse (0.4 sec). Since the targets are pretty large, and the movement well practiced, moving the hand between keyboard and mouse, and vice-versa, is relatively fast.

M - Mental act of routine thinking or perception (0.6 - 1.35 sec; use 1.2 sec). The **M** operator is intended to represent routine thinking, not complex, lengthy, problem-solving, racking the brain, or creative meditations. In a variety of routine computer usage tasks such as word processing and spreadsheet usage, these routine pauses are fairly uniform in length, justifying the simplifying assumption that all Ms take the same amount of time, around one sec.

Question #6 [10 points total]: Goal-oriented action

Norman's model of goal-oriented action consists of 7 stages that span 3 kinds of activities (goal setting, execution and evaluation), listed in the box on the right.

Two major points of Norman's model are that

(a) There are perceptual "gulfs" to be crossed as the user proceeds from goal setting to execution, and from execution to evaluation of his/her action – i.e. the user has to figure out how to get from one action stage to the next.

(b) Users often iterate in this process.

1. **Establishing** the goal to be achieved
2. **Forming** the intention for action to achieve goal
3. **Specifying** the action sequence corresponding to the intention
4. **Executing** the action sequence
5. **Perceiving** the system state
6. **Interpreting** the perceived system state
7. **Evaluating** the system state with respect to the goal and the intentions

Below is a description of a user proceeding through a task that should be familiar to you. Please state what Samantha (the user in the example) might do to cross each gulf. There are multiple good answers.

Samantha Serious, a student in CPSC 444, is trying to figure out when the first deliverable for the term project is due, and what exactly it includes. She hasn't yet explored the Project page of the 444 website, so doesn't know for certain what she'll find there; however, she has looked at the schedule page and downloaded lecture notes from it. She starts now at the main (syllabus) page of the site.

Note: Do not feel you have to refrain from criticizing the 444 website in answering this question - base your answer on your own experience as a user of the site.

For each of the following, answer in about one sentence:

(a) What is Samantha's **goal**? [1 pts]

Goal is to determine when the first deliverable for the term project is due.

(b) How might Samantha "cross the gulf" **between goal and execution**? That is, after looking over the syllabus, what action might she decide on (specify) to move closer to her goal? [3 pts]

A couple of possible answers: she might remember that she saw something about due-dates on the schedule page (which she's already examined), and go there by clicking on the Schedule nav-bar and scroll through the page looking for the information; or, she might elect to try going directly to the projects page using the project nav bar button and scrolling through that page.

(c) How might Samantha "cross the gulf" **between execution and evaluation**? That is, once executed, how will she decide whether the action stated in (b) accomplished her goal? [3 pts]

She would simply ascertain whether the information she needs is found there. This is a matter of perception and interpretation (Norman's steps 5 and 6); i.e. no action taken.

(d) Let's say she determines that the action stated in (c) failed to accomplish her goal. What might she do next? What step in Norman's model does this correspond to? [3 pts]

She might decide she needs to go somewhere else in the site to find all the details she needs (for example, date is on the schedule page, but details are a couple of layers down in the project page). She thus iterates all the way back to Norman's steps 1 (establishes a new goal), and on through steps 2-7. Alternatively, she might just give up at this point!

Question #7 [18 points total]: Persuasion

Briefly describe a product or website that employs the technique of "**macrosuasion**". It can be a real existing product/site, or a fictitious one (i.e. you can make it up for the purpose of this question). The topic of macrosuasion may be anywhere on the spectrum of conventional / serious to radical / absurd; but it must do a good job of illustrating the concept. **Do not use any of the examples shown in class; no credit will be given for them**.

(a) What is the product/site's name or title? If you're not sure of the actual name, approximate it; and of course make up the name of a fictitious product/site. [1 pts]

Examples from class included: Baby Think It Over, QuitSmoking,, HygieneGuard (or something like that)

(b) State the intent or goal of the product/site's macrosuasion, in about one sentence. [4 pts]

Baby Think It Over: persuade teenagers to not engage in practices that might result in their having to care for a baby before they're ready to.

(c) List two mechanisms by which the product/site attempts to achieve this goal. Use about one sentence to describe each mechanism. [6 pts]

1. *Produces a doll that cries all the time, which the teenager needs to carry around with her/him; for use by high school educators*

2. *Training materials for instructor to use*

Next, you will briefly describe a product or website which uses (somewhere within it) the technique of "microsuasion". Again, you may use either real or fictitious sites or products. **Do not use any of the examples (applications or mechanisms) shown in class; no credit will be given for them.**

(d) What is the site's or application's general function? (Your answer should be at the level of "a web search engine", "personal accounting software", "internet chat room", etc.) [1 pts]

An example from class: ebay customer rating system

(e) State the intent or goal of the site's microsuasion, in about one sentence. [3 pts]

Persuade customers to be responsible purchases / sellers, i.e. follow through on their stated commitments.

(f) Describe the microsuasive element, using about one sentence. [3 pts]

Shows colored stars and numbers next to customer's profile whose value indicates their record.

Question #8 [16 points total]: Questionnaires

On the next page is an example of a not particularly well-designed questionnaire, along with a note on its purpose and how it is to be administered.

(a) **List 4 problems with the questionnaire and its administration** in the left column of the table below. Identify the concern specifically: e.g. where relevant, identify location directly on questionnaire by circling and annotating, then referring to this annotation in the table. Note that problems may extend beyond the text and appearance of the questionnaire itself. There are more than 4 problems to be found. [2 pts per problem correctly identified]

(b) **For each problem identified, describe a remedy.** For example, suggest improved language, methodology or inclusion of missing elements. [2 pts per remedy]

One problem and a possible remedy are filled in as an example.

PROBLEM	REMEDY
Irrelevant questions: e.g. (f)"How much time did you spend parking?" It is unlikely that this matters in terms of choice of kiosk vs. traditional purchase method.	*Eliminate irrelevant questions and replace with others that would lend more insight on the questionnaire's purpose.*
1.	
2.	
3.	
4.	

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Example Problems & Remedys (other reasonable answers accepted):

PROBLEM	REMEDY
Invasive, private information requested which is not needed (name and address)	
Informative, non-obtrusive profiling info (such as age range, computer experience etc) is not requested	
Ambiguous question (rating scale unclear): "How often do you buy movie tickets?"	
Non-representative set of respondents. It isn't being offered to those who have chosen not to use the kiosk.	
Moviegoers are here to have fun. They might be unwilling to fill out a long free-text section (process confusing) .	
Doesn't say what to do with the questionnaire when it's been completed.	

Name: _____   **Student ID Number:** _____

Questionnaire for Question #8

The following questionnaire is intended to determine how well a recently redesigned movie-ticket-purchase kiosk, which allows moviegoers to avoid standing in line for a human salesperson, is succeeding in attracting new users. The kiosk is located immediately outside the theatre. A theatre employee hands the questionnaire to individuals just after they have completed a credit card purchase using the kiosk.

Luna Cinema is eager to have your participation in this survey to rate your satisfaction with the new Luna Cinema Ticket Kiosk. Since you have just purchased a ticket using this system, we hope you will spend a few minutes telling us how you liked it.

(a) Your full name: _____

(b) Your mailing address: _____

(c) How often do you buy movie tickets? Circle one:
    1. Very Often   2. Often   3. Sometimes   4. Rarely   5. Never

(d) How much money do you typically spend on a movie ticket? _____

(e) For how many people did you purchase tickets tonight? _____

(f) How much time did it take you to finding parking tonight?
    1. >20 minutes   2. 10-20 minutes   3. 0-10 minutes   4. Found parking immediately   5. Didn't drive

(g) How fast was this process relative to purchasing your ticket(s) through a salesperson? Circle one:
    1. Much slower   2. A little slower   3. About the same   4. A little faster   5. Much faster

(h) Did you find the process confusing in any way? _____

 If so, how? _____

_____

_____

Luna Cinema thanks you very much for your participation! Enjoy your movie.

Question #9 [20 points total]: Experiment Design

A graphical driving simulator intended for driver training has been "improved" (we hope) by adding haptic force feedback in the steering wheel. The driving student now feels bumps when he drives over or collides with obstacles, and resistance when he turns too sharply. He also feels vibrations when he drives over the speed limit (it is a simulation of an older car which does not like to move very fast). As with the previous design, he also has visual feedback in the form of a graphical display of a road and obstacles and signage.

Design a controlled experiment to **test whether this addition of force feedback improves the tendency of the driving student to drive safely during the simulation**, by defining each of the following experiment components. Note that there are many possible experiments; we are looking for reasonable answers.

(a) Hypotheses [4 pts] Experimental: Null:	*e.g., Haptic feedback reduces the number of driving errors that the driver makes during the simulation.* *Note: must state a measurable performance parameter. Any reasonable one accepted.* *Haptic feedback has no effect on the number of driving errors made during the simulation.*
(b) Ideal subject pool [2 pts]:	*At least two possibilities: novice drivers and "problem drivers" – e.g. those with poor driving records.*
(c) Experiment task. Be concise but specific; include relevant details relating, for example, to test environment the subject will encounter, and how you will appropriately motivate the subject. [5 pts]	*e.g., Drive a test route with and without haptic force feedback. The test route should include a variety of obstacles and posted speed limits. The subject will be directed to complete the test course as quickly as possible while driving safely.*
(d) Independent variable [2 pts]:	*Presence or absence of haptic feedback as described above*
(e) Dependent variable [2 pts]:	*1. Time taken to complete course* *2. Number of safety-related errors made (e.g. speed limit exceeded, center line crossed, etc).*
(f) Possible nuisance variable (list one) [2 pts]:	*e.g., whether subject has had past experience with haptic feedback in driving games, or with this simulator in general. Also driving history in general.*
(g) Randomization (at least 2 ways) [2 pts]:	*- Order of presentation of haptic / no haptic condition* *- Order of types of obstacles presented during driving task* *- Individual differences*
(h) Analysis (type of t-test) [1 pt]:	*Paired comparison (to deal with individual differences)*

Question #10 [18 points total]: Statistical Analysis

For this question, you will carry out a simple t-test on the provided data and make an experimental conclusion.

Sam Sleepresearcher hypothesizes that people who are allowed to sleep for only four hours will do significantly better on a user interface test of a web search function than those who are allowed to sleep for eight hours. He brings sixteen participants into his lab and randomly assigns them to one of two groups. In one group he has participants sleep for eight hours and in the other group he has them sleep for four. The next morning he administers the SPAT (Sam's Performance Ability Test) to all participants, wherein each participant must find as many specified items on the web as possible within a time limit using the provided search tool.

The data provided on the following page are subject performances on the SPAT. They range from 1-9 with high scores representing better performance.

In computing your t-statistic,

- **Show all intermediate steps,** making use of blank columns in the data table as needed (be sure to label any column used).

- For this particular problem, choose appropriately from among the following formulas and use the table of t-values that follows:

$$s^2 = \frac{SS}{N-1}$$

$$t = \frac{\left|\bar{X}_1 - \bar{X}_2\right|}{s_{ed}}$$

$$s_{ed} = \sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}$$

$$SS = \sum(X_i - \bar{X})^2$$

$$sd = \sqrt{s^2}$$

Provide answer and show all work on following page.

Question #10 (continued)

8 hours sleep (Group A)				4 hours sleep (Group B)			
Data				**Data**			
5				6			
7				1			
5				4			
3				6			
5				5			
3				4			
4				1			
9				2			

(a) What is t? [8 pts] _____

(b) How many degrees of freedom does this t-statistic have? [2 pts] _____

(c) Can Sam accept his hypothesis? Use the table on next page, and **justify answer quantitatively**. [6 pts]

Question #10 (solution)

8 hours sleep (Group A)				4 hours sleep (Group B)			
raw	$r-M_A$	$(r-M_A)^2$		raw	$r-M_B$	$(r-M_B)^2$	
5	-0.13	0.02		6	2.38	5.64	
7	1.88	3.52		1	-2.63	6.89	
5	-0.13	0.02		4	0.38	0.14	
3	-2.13	4.52		6	2.38	5.64	
5	-0.13	0.02		5	1.38	1.89	
3	-2.13	4.52		4	0.38	0.14	
4	-1.13	1.27		1	-2.63	6.89	
9	3.88	15.02		2	-1.63	2.64	
$M_A=5.13$		$SS_A=28.88$		$M_B=3.63$		$SS_B=29.88$	
$df=7$		$s^2= \\ SS_A/7=$	4.125	$df=7$		$s^2= \\ SS_B/7=$	4.268

$$t = \frac{\left|\bar{X}_A - \bar{X}_B\right|}{\sqrt{\dfrac{s_A^2}{N_A} + \dfrac{s_B^2}{N_B}}} = \frac{\left|5.13 - 3.63\right|}{\sqrt{\dfrac{4.125}{8} + \dfrac{4.268}{8}}} = 1.464$$

(a) What is t? [8 pts] ____1.464____

(b) How many degrees of freedom does this t-statistic have? [2 pts]____14____

(d) Can Sam accept his hypothesis? Use the table on next page, and **justify answer quantitatively**. [8 pts]

> *No, hypothesis is rejected. Looking here for numerical values for the following:*
>
> *what's the largest value of p that permits rejection? 0.05 (2 pts)*
>
> *Critical value of t at that p and type of test? 2.145   (2 pts)*
>
> *–> 1.464 < 2.145 –> can't reject null hypothesis   (4 pts)*

df	Critical Values of Student's t (2-tailed)					
p ->	0.20	0.10	0.05	0.02	0.01	0.001
1	3.078	6.314	12.706	31.821	63.657	636.619
2	1.886	2.920	4.303	6.965	9.925	31.598
3	1.683	2.353	3.182	4.542	5.841	12.941
4	1.533	2.132	2.776	3.747	4.604	8.610
5	1.476	2.015	2.571	3.365	4.032	6.859
6	1.440	1.943	2.447	3.143	3.707	5.959
7	1.415	1.895	2.365	2.998	3.499	5.405
8	1.397	1.860	2.306	2.896	3.355	5.041
9	1.383	1.833	2.262	2.821	3.250	4.781
10	1.372	1.812	2.228	2.764	3.169	4.587
11	1.363	1.796	2.201	2.718	3.106	4.437
12	1.356	1.782	2.179	2.681	3.055	4.318
13	1.350	1.771	2.160	2.650	3.012	4.221
14	1.345	1.761	2.145	2.624	2.977	4.140
15	1.341	1.753	2.131	2.602	2.947	4.073
16	1.337	1.746	2.120	2.583	2.921	4.015
17	1.333	1.740	2.110	2.567	2.898	3.965
18	1.330	1.734	2.101	2.552	2.878	3.922
19	1.328	1.729	2.093	2.539	2.861	4.883
20	1.325	1.725	2.086	2.528	2.845	3.850
21	1.323	1.721	2.080	2.518	2.831	3.819
22	1.321	1.717	2.074	2.508	2.819	3.792
23	1.319	1.714	2.069	2.500	2.807	3.767
24	1.318	1.711	2.064	2.492	2.797	3.745
25	1.316	1.708	2.060	2.485	2.787	3.725
26	1.315	1.706	2.056	2.479	2.779	3.707
27	1.314	1.703	2.052	2.473	2.771	3.690
28	1.313	1.701	2.048	2.467	2.763	3.674
29	1.311	1.699	2.045	2.462	2.756	3.659
30	1.310	1.697	2.042	2.457	2.750	3.646
35	1.31	1.69	2.030	2.438	2.724	3.591
40	1.303	1.684	2.021	2.423	2.704	3.551
45	1.301	1.679	2.014	2.412	2.69	3.520
50	1.299	1.676	2.009	2.403	2.678	3.496
55	1.297	1.673	2.004	2.396	2.668	3.476
60	1.296	1.671	2.000	2.390	2.660	3.460
65	1.295	1.669	1.997	2.385	2.654	3.447
70	1.294	1.667	1.994	2.381	2.648	3.435
75	1.293	1.665	1.992	2.377	2.643	3.425
80	1.292	1.664	1.990	2.374	2.639	3.416

Name: _____   **Student ID Number:** _____

Question #11 [16 points total + 5 extra credit]: Physical Interfaces

(a) What's the functional difference between a "button" and a "handle"-type physical computer interface? What *kind* of control activity does each lend itself well to? [4 pts]

> *Buttons are for initiating something automatic; handles are for maintaining close control.*
>
> *Alternatively: buttons are for discrete actions, handles are for continuous actions.*
>
> *2 pts for defining each of buttons and handles in one of the above 2 ways.*

(b) Give 3 examples of computer-supported interfaces or functions of interfaces that are well suited to **button**-like interaction. [6 pts]

   1.

   2.

   3.

> *Any kind of discrete control. E.g. typing, punching calculator buttons, power switch, "send" button on an online form.*

(c) Give 3 examples of computer-supported interfaces or functions of interfaces that are well suited to **handle**-like interaction. [6 pts]

   1.

   2.

   3.

> *Any kind of continuous control. E.g., drawing / sculpting with a computer-based application, musical instrument (computer generated music).*

EXTRA CREDIT [1-5 pts]

Suggest an example (other than those shown in class) of a useful physical metaphor that could be implemented in a haptic interface. For example, mentioned in class where the debit card whose "weight" you could feel when you swiped it, representing the amount of money in the account; and the "clutched film reel" metaphor for browsing streaming media such as video. Partial credit will be given according to the quality and innovativeness of the idea. *This is a shameless ploy to exploit the creative brains in this class for research ideas. If I think it's really good* and *original, I'll ask you for permission to implement the metaphor in my research lab – and if it* still *seems good after prototyping, credit you appropriately in any publications which result.*

Blank page for extra work