Score Sheet. 600.445 Homework #1 - Fall 2008

Name:___________________; Email: ______________
Name:___________________; Email: ______________

I/we worked _____ alone on this assignment and followed all other guidelines:

________________________  ____________________________________
signature                    date
________________________  ____________________________________
signature                    date

1. (40 points)
   A. (10 points) __________
   B. (15 points) __________
   C. (15 points) __________

2. (60 points)
   A. (20 points) __________
   B. (20 points) __________
   C. (20 points) __________

TOTAL __________

I/we worked alone on this assignment and followed all other guidelines:

________________________
signature

________________________
date

________________________
signature

________________________
date
1. I would really appreciate typed, double spaced and READABLE output that is firmly attached together. Sketches can of course be hand drawn. I am not looking for beauty, just legibility and room to mark them up. Generous margins are also nice.

2. Put your **name and email address** on each sheet and number the sheets.

3. Attach the grade sheet as the first sheet and attach all sheets together.

4. You must include a self-addressed, seal-able 8 ½ x 11 inch envelope if you expect to the homework to be returned (per JHU’s interpretation of FERPA).

5. You should work in teams of two on this exercise. In some future problems you may be asked to work alone, but you may do this one together.

6. You are encouraged to make free use of any published materials, the web, etc. in developing your answer but a) you must give full and proper citations to any references consulted and b) you may not consult, discuss, or otherwise communicate about this assignment with any human being except your lab partner, the course instructor, or the TAs.

7. I do not expect truly expert answers at this point, nor am I expecting a great deal of clinical expertise beyond that included in the referenced book chapters. The main purpose of this exercise is to get you thinking analytically about the relationship between systems, application needs, and technology.
Fragments in the heart

Note: These slides provided by Dr. Aleksandra Popovic, of Philips Research

**Origin**
- Direct penetration
- Embolization from extremities

**Position**
- Lodged in the tissue
- Moving in one ventricle
- Moving between heart chambers

**Clinical picture**
- Asymptomatic
- Symptomatic

**Treatment**
- Conservative
- Catheter
- Surgery
Examples

Figure 1. Chest x-ray films showing a bullet localized in the right ventricle after being propelled through the inferior vena cava to the right atrium from the penetration site in the leg.

Examples

Figure 2. Chest x-ray films of a 2.5-year-old boy with a needle infixed in the left ventricle approaching the cardiac cavity.

Examples

Figure 2. Chest x-ray films of a 2.5-year-old boy with a needle infixed in the left ventricle approaching the cardiac cavity.

Examples

Figure 3. The grenade fragment extracted from the left atrium.

Figure 5. Fragment of the circular saw that penetrated the right ventricle.

Examples

Figure 6. Dogliotti’s ring, widely used for closed commissurotomy of the mitral valve during the 1950s and 1960s, which had been left in the left atrium.

First heart surgery – shrapnel removal

Note: These slides provided by Dr. Aleksandra Popovic, of Philips Research

- The first successful heart surgery was shrapnel removal in World War 2.
- The surgeries were performed by Dr. Dwight Harken, a 32 year old U.S. Army surgeon.
- Dr. Harken developed the technique in animal trials:
  - First trial: 14/14 animals died
  - Second trial: 7/14 animals died
  - Third trial: 2/14 animals died
- Dr. Harken performed 140 shrapnel removal surgeries. All patients survived.
- Dr. Harken and his team had only 4 minutes from opening to closing the heart muscle (more than 4 minutes without blood circulating means certain death).
- Cardiopulmonary bypass was invented in 1951 allowing Dr. Harken to expand his methods to repair of valves, thus giving birth to cardiac surgery.
- Today, surgeons use the same method developed in 1940s.

Link to an interview with Dr. Harken: http://www.ctsnet.org/sections/residents/pioneerinterviews/article-1.html
Standard surgical workflow

1. Stabilize patient with a chest tube
2. Stop heart with cardio-pulmonary bypass
3. Detect foreign body in images
   - X-ray imaging
   - Ultrasound imaging
4. Incise skin through midline
5. Open chest bone
6. Open pericardiac sac
7. Open myocardium (heart muscle)
8. Remove foreign body with pincers or finger
9. Repair myocardium using patches
10. Close sternum using staples

Technique established during WW2 by US Army surgeons

Note: These slides provided by Dr. Aleksandra Popovic, of Philips Research
Literature

Note: These slides provided by Dr. Aleksandra Popovic, of Philips Research


- US Army guidelines:

Question 1 – Analysis of existing procedure

A. (10 points) Using the suggested literature and other material that you may find, prepare a short (2 page max) summary of this procedure including a description of frequency, treatment options, outcomes, etc. CITE all sources used.

B. (15 points) Develop an outline for evaluating this procedure, including such factors as “cost”, “safety”, “effectiveness of pain relief”, “accuracy”, “time”, etc. For each such criterion, include:
   • Short definition or explanation of the criterion
   • Short discussion of how how that criterion should be assessed (e.g., units of measure, means of gathering information)
   • Short discussion of how important each criterion is to each relevant group affected (patient, surgeon, hospital administrator, insurance company, employer, etc.)

C. (15 points) Use this outline to evaluate the existing manual methods using these criteria.
Question 2 – Identifying alternatives

A. (20 points) Sketch an alternative approach using computer assistance to enhance this procedure. Do not write a book. I am looking for 1-2 pages maximum, possibly with a sketch or two.

B. (20 points) Sketch a second, distinct approach using computer assistance, with the same sort of information and discussion included in Part 2.A.

C. (20 points) Develop an outline evaluating the two approaches using the criteria developed in Question 1. Your analysis should compare your approaches to each other and to existing manual practice.
Important NOTE

There is no single “right” answer to these questions, and I am well aware that people may not have either the experience or the knowledge to make highly credible estimates of things like schedules and costs. The purpose of the exercise is to get you to think.

In grading the answers, we will be looking more at your reasoning and your approach to the problem than at the specific “correctness” of any technical solutions you come up with.

At the same time, do try to keep sight of the specific goals of the application, and don’t simply resort to science fiction. An answer proposing well trained termites is not likely to score very well.