

Score Sheet. 600.445/645 Homework #1 - Fall 2013

Name: _____; Email: _____

Name: _____; Email: _____

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|--------------------|----------------|-------|-------|
| 1. | (25 points) | | |
| | A. (10 points) | _____ | |
| | B. (5 points) | _____ | |
| | C. (5 points) | _____ | |
| | D. (5 points) | _____ | _____ |
| 2. | (50 points) | | |
| | A. (20 points) | _____ | |
| | B. (20 points) | _____ | |
| | C. (10 points) | _____ | _____ |
| 3. | (25 points) | | |
| | A. (10 points) | _____ | |
| | B. (10 points) | _____ | |
| | C. (5 points) | _____ | _____ |
| TOTAL (110 points) | | | _____ |

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

signature date

signature date



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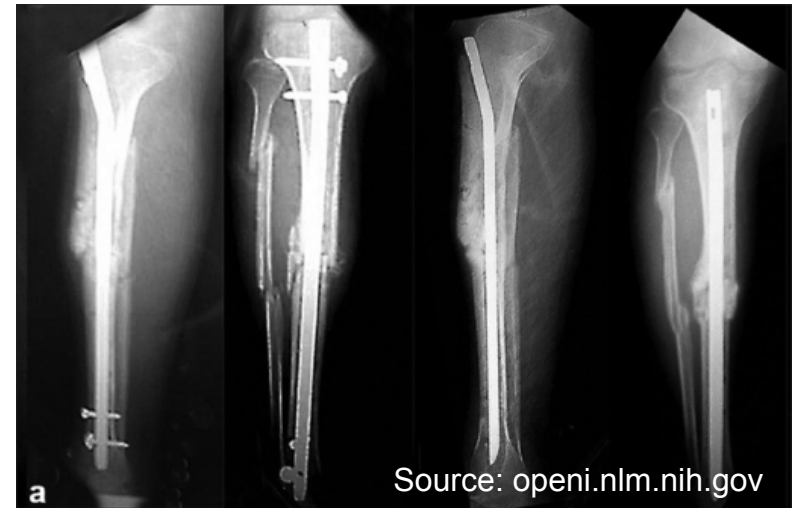
General Notes and Instructions

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. The one exception is that you should **not** refer to previous years' homework.
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.



Problem: Intramedullary “Nails” for Fractures

- Insertion of a metal rod into medullary canal of bone to treat long bone fracture
- Basic steps include
 - reduction of fracture (typically with x-ray fluoroscopy) & insertion of a guide wire
 - Reaming the cavity
 - Inserting the intramedullary rod
 - Inserting proximal & distal cross-locking screws
- Two common techniques to assist in drilling the cross-locking screw holes
 - External jig attached to implant
 - X-ray fluoroscopy to line things up



<http://www.youtube.com/watch?v=MI2Jvgt9Z8c>

Cross-locking screws



Jig technique

<https://www.youtube.com/watch?v=NhYUAIEmvw>

“Perfect circle” x-ray technique



<http://www.youtube.com/watch?v=dXHuCo27ZgQ>

Additional material

There is extensive material available online about this procedure. One excellent guide to clinical literature on the subject may be found in the Wheeless' Textbook of Orthopaedics, from Duke Orthopaedics at

http://www.wheelessonline.com/ortho/tibial_fractures_technique_of_im_nailing

Some videos of procedures are in the table below, but there are many more

Description	URL
Animation of femoral nailing (2 mins)	http://www.youtube.com/watch?v=MI2Jvgt9Z8c
Animation of femoral nailing procedure (6 mins)	https://www.youtube.com/watch?v=wA6NhmoKonk
Animation of femoral nailing	http://www.youtube.com/watch?v=TxMFxV53M3E
"Perfect circle" x-ray technique for cross-locking screws	http://www.youtube.com/watch?v=dXHuCo27ZgQ
Closed x-ray reduction internal fixation of femur fracture	https://www.youtube.com/watch?v=l9P1XUq-zQs
Surgical video of tibial nail insertion procedure (13 mins)	https://www.youtube.com/watch?v=NhYUAIteMvw

Question 1 – Analysis of existing procedure

- A. Develop an outline for evaluating this procedure, including such factors as “cost”, “safety”, “effectiveness”, “accuracy”, “time”, etc. For each such criterion, include:
- Short definition or explanation of the criterion
 - Short discussion of 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.)
- B. Use this outline to evaluate the existing manual jig methods using these criteria
- C. Use this outline to evaluate the existing x-ray method using these criteria
- D. Based on your evaluation, explain briefly why one might be preferred over the other, and in what circumstances



Question 2 – Identifying alternatives

- A. 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. Sketch a second, distinct approach using computer assistance, with the same sort of information and discussion included in Part 2.A.
- C. 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.



Question 3 – Fleshing out the preferred embodiment

- A. Based upon your analysis in Question 2, select one of your proposed system solutions for further design evaluation. For this design, provide an additional 2-3 pages total (discussion + sketches) outlining the technical approach. Your discussion should clearly define
- Preoperative, intraoperative, and postoperative information needed.
 - How this information will be obtained.
 - Important components and human interfaces.
 - Key coordinate systems and their relationship to each other
 - What components need to be developed.
 - What components (if any) need to be “invented”
- B. Summarize the step-by-step procedural flow for your solution. What will the surgeon or other members of the team do at each step? What information will be needed at each step? How will this be obtained?
- C. Discuss the steps, timeline, and estimated resource requirements to implement your solution for clinical use



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.

