Week 4

1. Engineers’ Salary Survey
2. Design project (see Design Project Schedule on web)
3. Professionalism and Ethics (chapter 1.10 in book)
Engineering Salary Survey

Source: http://www.abbott-langer.com/asmesumm.html?pn02
Engineering Salary Survey

The median annual income reported in a recent survey (2004) of the compensation of mechanical engineers was $83,236, with the middle 50% falling between $62,000 and $100,000, according to Dr. Steven Langer, President of Abbott, Langer & Associates, Inc., Crete, IL.
The composite highest-income practitioner in this field (salary plus cash bonus and/or cash profit sharing) is the Research Vice President/Director with a median income of $135,000. Far toward the other end of the income spectrum, Junior Engineers have a median annual income of $50,000.
The median total cash compensation of some included in the 2002 survey report are:

- Presidents "B" $130,500
- Engr. Directors/Vice Presidents $110,000
- Professors $106,700
- Principal Consultants $100,000
- Environmental Managers $96,990
- Senior Engineers $79,800
- Sales Representatives $74,000
Engineering Salary Survey, cont’d

Compensation varies considerably. Median incomes are highest for independent consultants ($99,500), and in financial organizations ($118,000), textile mill product manufacturing ($96,000), and petroleum/coal/natural gas extraction & refining firms ($95,000);
Engineering Salary Survey, cont’d

Median incomes are lowest in firms manufacturing home appliances ($63,000) and circuit boards ($63,500), printing firms ($63,800), and state government ($64,000).
When level of education is taken into account, mechanical engineers with a **doctoral degree** earn a median annual income of $93,750, 32% higher than those with a bachelor's degree ($70,950). Mechanical engineers with **under one year of experience** have a median income of $49,900, only about one-half that of the 25-plus-year veteran ($100,000).
Chapter 1.9
Engineering Education

Some personal observations:
• Observe market trends continuously. Internet job sites are an excellent resource.
• The highest demand is typically in new technologies (often the most interesting, but also the most challenging)
About Week 3 Lab Assignment: Begin Literature Search

Your Sources:

- Library
- Web
- US Patent office
US Patent example:

United States Patent 6,491,566
Peters, et al.
December 10, 2002

‘Toy Robots’
Legally known as:
“Sets of toy robots adapted to act in concert, software and methods of playing with the same “
Toy robots are provided that act in concert with each other. A player issues high level team commands to a processor. The processor interprets the team command to derive individual low level commands for the toy robots. A transmitter transmits the low level commands to the toy robots, which then act in concert.
Fig. 4

400

OBSERVE ACTION OF OPPONENT TOY ROBOT(S)

410

INPUT STATUS OF OWN TOY ROBOT(S)

420

DETERMINE PLAN TO COUNTER THE OBSERVED ACTION

430

ISSUE TEAM COMMAND TO EFFECTUATE THE PLAN

440

ENCODE TEAM COMMAND IN MASTER SIGNAL

450

TRANSMIT MASTER SIGNAL TO MASTER TOY ROBOT

460

DECODE MASTER SIGNAL TO REPRODUCE TEAM COMMAND

470

480
Fig. 5

1. RECEIVE NEXT PAWN CONTROL SIGNAL
2. SIGNAL INTENDED FOR THIS PAWN TOY ROBOT?
   - YES: DECODE RECEIVED PAWN CONTROL SIGNAL, TO REPRODUCE PAWN CONTROL INSTRUCTION
   - NO: OVERWRITE PAWN STATUS CONDITION (REPORT STATUS CONDITION)
3. DETERMINE WHETHER PRESET PAWN STATUS CONDITION IS MET
4. TRANSMIT PAWN STATUS SIGNAL (REPORT STATUS CONDITION)
   - NOT MET: EXECUTE PRESET ACTION ROUTINE
   - MET: OVERRIDE REPRODUCED INSTRUCTION
What can we learn?

Creativity?

New Ideas?
Conclusion

Patents are an excellent resource for assessing the state of the art, and for generating new ideas.
Lab Assignment:
Begin Literature Search

Your Sources:
• Library: Visit the UNLV Library. The library has an on-line catalog. See: http://www.library.unlv.edu/
• Web
• US Patent office
Lab Assignment:
Begin Literature Search

Your Sources:
• Library
• **Web**
  Use search engines such as Google.
  Also use Image search options
• US Patent office
A final remark:

Motivation: Study patents and literature for your own benefit. You will come up with new ideas. Knowledge will make you an expert, and will let you enjoy the project a lot more.
Chapter 1.10 Professionalism

Professional Registration
Application for Professional Engineer Licensure

(Discipline) ...........................................

☐ Reciprocity (Fee $200)
☐ Exam (Fee $225 – Structural see Fee List)

The Appropriate Application Fee Must Accompany This Application
Applicant’s name: 

Address: 

[space for applicant’s name and address]

is seeking licensure as a (discipline) ________________ Engineer in Nevada and has sent you this request for a professional reference. We understand that you are a Licensed Professional Engineer (license may be in any state) and have personal knowledge of the applicant’s engineering work, character and ethics. Please complete, sign, then stamp or seal this form. Place it in an envelope; seal and sign the envelope according to the instructions, then return the envelope to the Board office. **This Reference is confidential** and will not be accepted by the Board if not properly completed as instructed. **THE NEVADA BOARD HAS ON FILE A NOTARIZED AFFIDAVIT RELEASING ALL REFERENCES, EMPLOYERS AND FORMER EMPLOYERS, NAMED BY THE APPLICANT, FROM ALL LIABILITY FOR ANY DAMAGE WHATSOEVER FOR GIVING INFORMATION AS REQUIRED ON THIS FORM.**

**Applicant:** Describe up to 3 projects you had full or partial responsibility for while working with this professional engineer. Include dates, locations, and descriptive statements defining design work performed.

(Attach an additional sheet if more space is needed)

1. 

2. 

3. 

[space for additional projects]
What is a ‘Professional Engineer (PE)?

Licensing

Obligations
What is a ‘Professional Engineer (PE)?

By acquiring a license from its State Board, a Professional Engineer meets a set of minimal requirements for practicing the engineering profession in his/her field.
What is a ‘Professional Engineer (PE)?

**Obligations:** As other licensed professionals, the PE must protect the ‘safety, health, and welfare of the public’

**Caution:** Your PE stamp of approval makes you legally responsible for the safety of the design bearing your signature. As you shall see, this is a significant responsibility.
CODE OF ETHICS OF ENGINEERS

THE FUNDAMENTAL PRINCIPLES

Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:
I. using their knowledge and skill for the enhancement of human welfare;
II. being honest and impartial, and serving with fidelity the public, their employers and clients;
III. striving to increase the competence and prestige of the engineering profession; and
IV. supporting the professional and technical societies of their disciplines.

THE FUNDAMENTAL CANONS

1. Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.

2. Engineers shall perform services only in the areas of their competence.

3. Engineers shall issue public statements only in an objective and truthful manner.

4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.

5. Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.

6. Engineers shall act in such a manner as to uphold and enhance the honor, integrity and dignity of the profession.

7. Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional development of those engineers under their supervision.

346 East 47th Street New York, NY 10017

*Formerly Engineers' Council for Professional Development. (Approved by the ECPD Board of Directors, October 5, 1977)

Code of Ethics for Engineers. (Accreditation Board for Engineering and Technology)
Science and Engineering

History – The first Universities
Gutenberg Printing Press ~1450
University Library in Leiden, ~1610
Look how far we have come:

Treadmill in Leiden, Netherlands

17th Century
Chateau de Versailles
Thirteen water-wheels powered 235 force pumps, which pumped up to 1 million gallons (5,000 m³) of river water into the reservoirs daily. The reservoirs were situated 325 ft (100 m) above the river.

Versailles: The King’s Waterworks (supplying his fountains)

Total Output: approx. 50 hp
Isaac Newton
Scientific Inquiry takes time and effort. Newton’s law:

\[ F = m \times a \]

- From Galileo’s fall experiments in Pisa, it took 100 years until Newton finally formulated it.
- Science is analytical and systematic, but generally NOT intuitive
Boulton & Watt Steam Engine, ~1800
Northern Pacific class Z-5

The first Yellowstone was built in 1928 by ALCO for the Northern Pacific for running throughout the high speed plains of North Dakota. The Yellowstone was designed with the largest firebox ever.
The Yellowstone was the largest steam locomotive in the world (at that time) and ALCO celebrated by serving dinner to 12 people seated in the firebox! The NP Yellowstones produced 5,000 HP.
The First IC Engine

Used coal gas,
About 10 m tall,
Free-flying Piston

Operation
Step 1: The gas/air mixture is compressed as the piston falls under its own weight.

Step 2: The compressed gas/air mixture is ignited, driving the piston up. (the work stroke)

This engine was installed in Selters, Germany, to pump mineral water.
Carl Benz’s First Motor car, 1886
Mercedes Motor car, 1910
Olds Assembly Line

America's greatest contribution to the automobile was mass production. The first steps by Ransom Olds were developed by Henry Ford in 1914 at Highland Park. Bodies were slid down a chute to fall onto the chassis.
Model T Ford
Ford’s Assembly Line

Mass-production techniques changed the way people work and live throughout the world.

The Model T put America on wheels. But the real revolution was the production technique developed in 1913. Ford Motor Co.'s moving assembly line, and the rapid spread of its mass-production methods, profoundly changed the way people work and live world-wide.
As William C. Klann, a foreman in Ford's engine-assembly shop, told it, he and his colleagues had visited slaughterhouses and had been impressed with how conveyors carried hogs and cattle through a disassembly process.

Why not use the same idea to speed up an assembly system? Mr. Klann and his colleagues began experimenting with a conveyor to speed up the assembly of one component of the Model T engine.
The body drop on the assembly line of the Highland Park Plant.
Nighthawks
by Edward Hopper
McCormick’s Reaper
Many inventions from the Industrial Revolution period are still used today:

the sewing machine (invented by Elias Howe),
the steel plow (invented by John Deere),
the reaper (invented by Cyrus McCormick),
vulcanized rubber (inv. by Charles Goodyear),

The Industrial Revolution greatly transformed the economies and societies of the U.S. and the other industrial countries.
Computers
A computer automatically performs logical (mathematical) operations on input information and puts out answers, according to a predetermined ´program´ of instructions.
Herman Hollerith’s Punchcard Machines

Hollerith won the competition for the delivery of data processing equipment to assist in the processing of the data from the 1890 US Census.
From 1936 to 1938, Konrad Zuse developed and built the first binary digital computer (Z1). A copy of this computer is on display in the Museum for Transport and Technology in Berlin.
Zuse completed the first fully functional program-controlled electromechanical digital computer in the world (the Z3) in 1941, but it was destroyed in 1944 during the war. The machine used electromechanical relays rather than vacuum tubes.
Eniac, 1946
Eniac, 1946
The Eniac

The ENIAC was a large-scale, general purpose digital electronic computer. Built out of some 17,468 electronic vacuum tubes, ENIAC was in its time the largest single electronic apparatus in the world. The ENIAC combined very diverse technical components and design ideas into a single system that could perform 5,000 additions and 300 multiplications per second. Although slow by today's standards - current microprocessors perform 100 million additions per second - this was two to three orders of magnitude (100 to 1,000 times) faster than existing mechanical computers or calculators.
1971: INTEL 4004

The first single chip CPU was the Intel 4004, a 4-bit processor meant for a calculator. It processed data in 4 bits, but its instructions were 8 bits long. Program and data memory were separate, 1K of data memory and a 4K of program memory (in the form of a 4 level stack, used for CALL and RET instructions). There were also sixteen 4-bit general purpose registers.
Aviation
What does he have to do with Aviation?
Leonardo’s Helicopter
1485 A.D.
La Montgolfière
1783
First Flight: Wright Brothers 1903
First Flight: Attempts and Accomplishments
The Airplane as Computer
The Future of Aviation
The Future of Technology

• More Automation. Why?

• How will automation shape future technologies?

• What do future technologies mean for YOU as future engineers?
Chapter 2
Engineering Design
Engineering Design is iterative:

You start with an idea, Encounter obstacles, and seek to overcome them until you arrive at the desired product.

1908 Buick
Engineering Design is iterative
The Wright Brothers systematically addressed every design problem.
Design Project Schedule:
structured along Chapter 2 of Textbook
How We Made the First Flight
by Orville Wright

“The flights of the 1902 glider had demonstrated the efficiency of our system for maintaining equilibrium. We felt that we were prepared to calculate in advance the performance of machines. Before leaving camp in 1902 we were already at work on the general design of a new machine which we proposed to propel with a motor. “
How We Made the First Flight
by Orville Wright

1902 Glider
How We Made the First Flight
by Orville Wright

“Immediately upon our return to Dayton, we wrote to a number of automobile and motor builders, asking whether they could furnish one that would develop eight-brake horse power, with a weight complete not exceeding 200 pounds. Finally we decided to undertake the building of the motor ourselves. “
The "Flyer" after it's first 3 1/2 second flight, a failure.
The first manned flight:
December 17, 1903. At 10:35 a.m.
Orville Wright takes off into a 27 mph wind. The distance covered was 120 feet.
MEG 100 Lab
Design Project

Your Assignment for
Week 5
Alternative Chassis Designs
MEG 100 Lab
Design Project

Your Assignment for
Week 6
Design Criteria

How to judge the design
MEG 100 Lab
Design Project

Your Assignment for
Week 6
Design Criteria

How to judge the design
MEG 100 Lab
Design Project

Your Assignment for
Week 7
Decision

Use Decision Matrix to identify the best design
Decision Matrix: Wood splitter example

Fig. 15.13: Freehand sketches showing three stages of the development of an idea.
Decision Matrix: Wood splitter example 2

1. CAP
2. HANDLES
3. MALLET
4. IMPACT PLATE
5. GUIDE ROD
6. WEDGE

Rod is threaded into wedge.

SLIDING MALLET

CUTTING WEDGE

WEDGE STAND

Fig. 15/2: Concept development of the sliding mass
# Decision Matrix

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weight $W$, percent</th>
<th>Selected concepts (see below)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Cost</td>
<td>30</td>
<td>6</td>
</tr>
<tr>
<td>Ease of operation</td>
<td>20</td>
<td>180</td>
</tr>
<tr>
<td>Safety</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>135</td>
</tr>
<tr>
<td>Portability</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>Durability</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80</td>
</tr>
<tr>
<td>Use of standard parts</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>70</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>755</td>
</tr>
</tbody>
</table>

**Rating scale $R$**

- Excellent: 9–10
- Good: 7–8
- Fair: 5–6
- Poor: 3–4
- Unsatisfactory: 0–2

**Selected concepts**

1. Auto-jack principle (item #2)
2. Drop wedge from elevation (item #10)
3. Spring-powered wedge (item #8)
4. Wedge driven by explosion (item #12)
5. Sliding mass (item #9)
6. Additional concepts

*Fig. 15.23* Each concept was rated on a scale of 0 to 10 for each criterion. The rating was multiplied by the criterion weight and then summed. Concept 5 was chosen as the optimum even though it did not receive the highest rating on three of the six criteria.
Chapter 1.10 Professionalism

**ethos**

*n. the distinctive character, spirit, and attitudes of a people, culture, era, etc.: the revolutionary ethos. [from Late Latin: habit, from Greek]*
Why Ethics?

Professionalism?

What do you expect when consulting a professional, e.g. a surgeon?
• Complexity: We cannot control every aspect of our lives. We depend on others in multiple ways.
• Interdependence: Our society is based on trust. Sometimes that trust is broken.
• Examples: Business: ENRON
              Medicine: Malpractice
              Law: Malpractice
Ethics failures range from the criminal (e.g. bribery, falsification) to neglect (failure to ascertain relevant facts) and ignorance.

There will always be failures that are NOT the result of crime or negligence. Sometimes failures result from insufficient knowledge about the behavior of engineered products.
The End