Week 12 - Monday

COMP 3100

Last time

- What did we talk about last time?
- Work days
- Before that:
  - Task identification
    - Work breakdown structure
  - Effort estimation
    - Traditional: Estimate size (in LOC or function points), then use analysis to predict person-months
    - Agile: Ignore final size but try to estimate work done per sprint in story points

Questions?

Project 4

Exam 2 Post Mortem

Financial and Economic Planning

Finances matter

- There are three software planning activities where finances are particularly important
- Buy or lease decision
  - Should software or hardware be bought or leased?
  - Will it cost more or less to use open-source software over time?
- Make or buy decision
  - Should software be written from scratch or bought?
- Go or no-go decision
  - Should a project (especially a software development project) be done or not?
  - If the project is already running but there are issues, should it be continued?

Financial conventions

- Assets are good things
- Liabilities are bad things
- Even so, for reasons best known to business people, debt is sometimes listed as an asset
  - Take an accounting course if you want to go deep into this
- We will look at money from some actor's perspective
  - Assets like deposits and revenues will be positive
  - Liabilities like costs and rental payments will be negative

Time value of money

- Money seems simple, but a lot of the madness business people talk about boils down to a question:
  - Would you rather be given $100 today or $120 a year from now?
- A similar question is:
  - Should you spend $1,000 now to prevent a security hole that is likely to cost your business $10,000 over the next 10 years?
- The answer to both of these questions is:
  - **It depends.**
- You **cannot** answer these questions without considering *what else* you would be doing with the money over the time periods in question
- Money doesn't simply sit around: it can be invested with the chance to grow over time

Simple interest

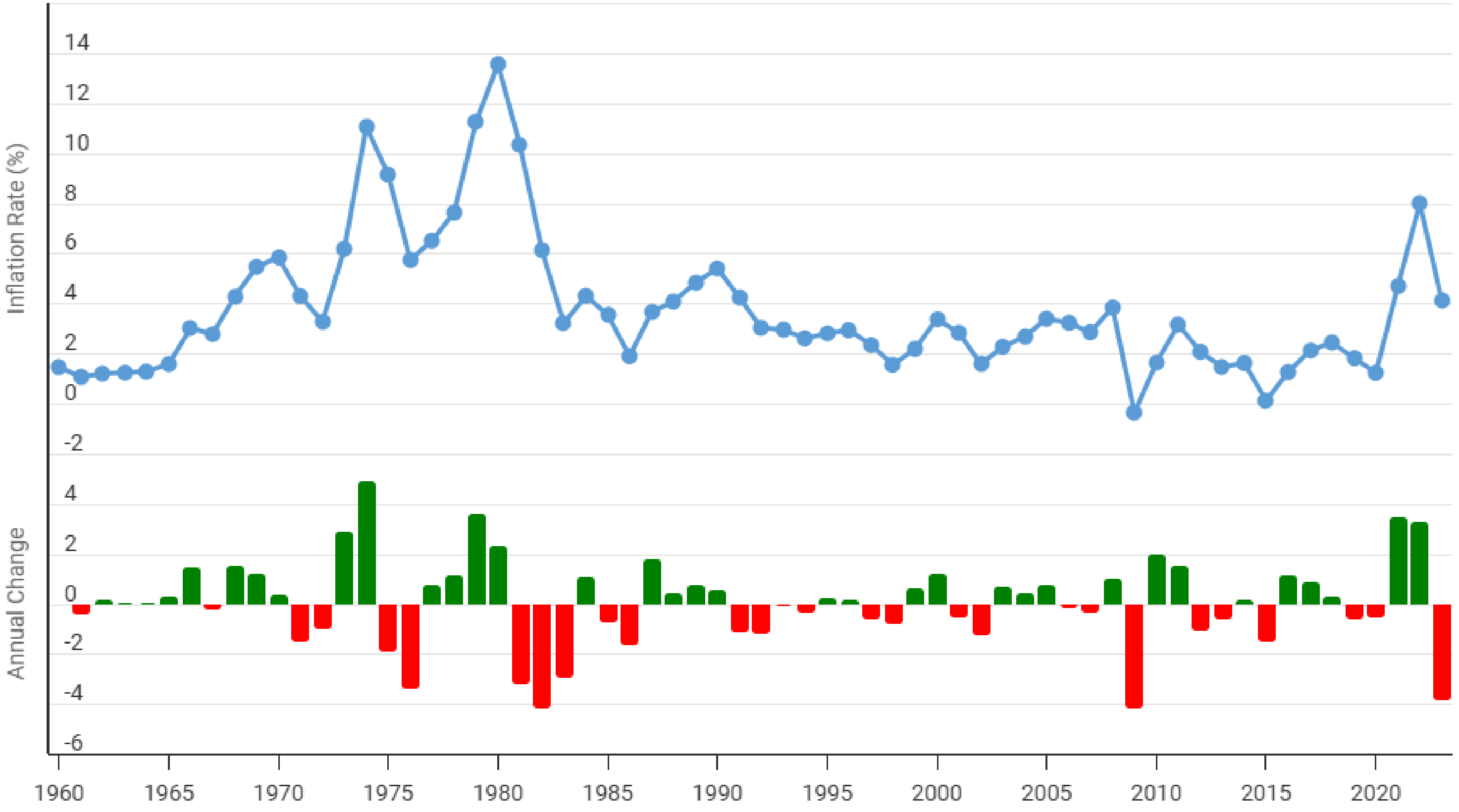
- What money is doing over time is earning **interest**
- Interest is built around a few variables:
  - The present value *P* of the money
  - The number of periods *n* during which the money will be earning interest
  - The periodic interest rate *r*, which is the percentage of the present value the money will earn each period
- With simple interest, the interest $I = P \cdot n \cdot r$
- Future value $F_n = P + I$
- Example:
  - $P = \$1{,}000, n = 5, r = 0.70\%$
  - $I = \$1{,}000 \cdot 5 \cdot 0.007 = \$35$
  - $F_n = \$1{,}035$

Inflation

- **Inflation** is the tendency for everything to get more and more expensive over time
  - Don't worry: Your salary rises to keep pace
  - Do worry: If everyone's salary rises too much, inflation will spiral out of control
- Deflation (negative inflation) is also possible
  - And harder to fix
- For your whole lives, you've seen average inflation rates between -0.4 and 8% (the 2022 high)
- We care in this discussion because if you make 3% interest but there was 3% inflation, the value of your money is the same
- Economists distinguish between the **real interest rate** (taking into account inflation) and the **nominal interest rate** (ignoring inflation)
- With the low interest rate of about 0.2% from 2012-2022, putting $1,000 in a savings account for 10 years to make $1,020.18 would give you money with the same value as about $800 when you started
  - **Yuck.**

Current inflation

- A number of factors have made inflation in the U.S. rise recently
- It's still not bad compared to the 1970s



Source: https://www.macrotrends.net/global-metrics/countries/USA/united-states/inflation-rate-cpi

Compound interest

- Our example with $1,000 at 0.7% interest for 5 years was simple interest
  - Which no one actually uses
- **Compound interest** means that when you earn interest in one period, you get to earn interest on that interest in the next period
- If we compounded every year, our example would become:
  - $F_n = \$1{,}000 \cdot 1.007 \cdot 1.007 \cdot 1.007 \cdot 1.007 \cdot 1.007 = \$1{,}035.49$
  - We got $0.49 more!
  - These interest rates are why savings accounts suck right now
- Compound interest: $F_n = P \cdot (1 + r)^n$
- Imagine you could earn 5% a year for 10 years
  - Simple interest: $F_n = \$1{,}000 + \$1{,}000 \cdot 10 \cdot 0.05 = \$1{,}500$
  - Compound interest: $F_n = \$1{,}000 \cdot (1.05)^{10} = \$1{,}628.89$

Discounted present value

- What if one of your options was to get $1,000 at some point in the future or to get some other sum right now?
- Working backwards from $1,000 with a given interest rate, what is the present value of that money?
  - $F_n = P \cdot (1 + r)^n$
  - $P = \frac{F_n}{(1+r)^n}$
- Calculating the present value from a future value is called **discounting**, which finds the **discounted present value**
- If someone promises $1,000 after 6 years with an interest rate of 8% compounded annually, the discounted present value is
  - $P = \frac{\$1,000}{(1.08)^6} \approx \frac{\$1,000}{1.586874} = \$630.17$
- Thus, if you can get more than $630.17 right now, it's better to do that
- If you can't, it's better to take $1,000 in the future

Example: buy or lease

- Consider a server you need for a 3-year project
- You have two options:
  - Buy the server for \$-4,000
  - Lease it for four payments: \$-1,000 now, \$-1,000 in a year, \$-1,100 in two years, and \$-1,150 in three years at the end of the project
- Naïve math says that \$-4,000 is better than \$-1,000 + \$-1,000 + \$-1,100 + \$-1,150 = \$-4,250
- However, we can apply the discounted present value to those later payments (because we could have been investing that money)
- As you can see in the table to the right, the discounted present value of \$-3,943.52 is better than \$-4,000

n	F_n	$(1 + r)^n$	$F_n / (1 + r)^n$
0	-1000.00	1.00	-1000.00
1	-1000.00	1.05	-952.38
2	-1100.00	1.1025	-997.73
3	-1150.00	1.157625	-993.41
			-3943.52

Example: go or no-go

- Someone wants to hire your company to develop and maintain software
- This project gets revenue (because they pay you) but incurs costs (because you have to pay developers and maintain equipment)
  - Revenues will be $100,000 a year for the first four years and $500,000 at the end
  - Costs will be $-450,000 immediately, $-80,000 for three years, and $-50,000 for the last two years, as you need less team to do maintenance and support
- This table summarizes the discounted present value, assuming that the discount rate is 4%

n	R	C	$(1 + r)^n$	$R / (1 + r)^n$	$C / (1 + r)^n$	Net
0	0.00	-450000.00	1.0	0.00	-450000.00	-450000.00
1	100000.00	-80000.00	1.04	96153.85	-76923.08	19230.77
2	100000.00	-80000.00	1.0816	92455.62	-73964.50	18491.12
3	100000.00	-80000.00	1.124864	88899.64	-71119.71	17779.93
4	100000.00	-50000.00	1.16985856	85480.42	-42740.21	42740.21
5	500000.00	-50000.00	1.2166529024	410963.55	-41096.36	369867.19
				773953.08	-755843.86	18109.22

Upcoming

Next time…

- Scheduling

Reminders

- **Turn in reflection on Project 3**
  - **Due tonight!**
- Work on Project 4
- Read Chapter 14: Scheduling