Administrivia

• Course evaluations due by Sunday
  – would like to see 50+% participation

• Final exam next Tuesday in KNE 220
  – section B at 2:30 – 4:20
  – section A at 4:30 – 6:20

• No notes or devices

• Midterm was 50 minutes and had 5 problems
• Final is 110 minutes, so…
Administrivia

• At most 9 problems

• 5 problems on reasoning & testing
  – primary focus, as promised
  – three categories of reasoning problems discussed before

• Other large problems on:
  – generics
  – subtypes, overloading vs overriding
  – TypeScript

• Small problems on anything else (comprehensive)
# US News CS Rankings

<table>
<thead>
<tr>
<th>Rank</th>
<th>University</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MIT</td>
</tr>
<tr>
<td>2</td>
<td>CMU</td>
</tr>
<tr>
<td>3</td>
<td>UC Berkley</td>
</tr>
<tr>
<td>4</td>
<td>Stanford</td>
</tr>
<tr>
<td>5</td>
<td>UIUC</td>
</tr>
<tr>
<td>6</td>
<td>UW</td>
</tr>
<tr>
<td></td>
<td>Cornell</td>
</tr>
<tr>
<td></td>
<td>Georgia Tech</td>
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</tbody>
</table>
CSE 331
Software Design & Implementation

Kevin Zatloukal
Spring 2023
Startups
Why Startups?

• Startups are a critical part of the economy
  – responsible for nearly all net job growth
  – young companies perform the majority of R&D

• Obvious examples of world-changing impact
  – PCs, ecommerce, ride hailing, EVs, cheap space flight, etc.

• Most startups fail
  – about 2/3rd lose all or most money invested
  – others must increase 5-10x to get normal investment returns

• “Expected to fail” path is not as scary as it sounds…
Myth #1: You’ll Go Bankrupt

- Startups are corporations (C corps)
- Corporations have “limited liability”
- In the event of bankruptcy
  - creditors split up the corporation’s assets
  - creditors do not get founder’s personal assets
- You can only lose the money you put in
Myth #2: You’ll Ruin Your Career

• “Founder of X” looks great on a resume
  – even when the company failed
  – demonstrates grit, risk-taking, leadership, etc.
  – requires you to learn a lot of different skills

• “Founder of X, Acquired by Y” looks even better
  – but the first part is already good

• A personal example…
Realities

• Asymmetric risk/reward
  – cannot lose more than you put in
  – can make a lot more than that
    • money, respect of peers, impact on world, etc.

• Forming a startup looks great on a resume

• Joining an existing startup also has benefits
  – more learning
  – more opportunity for rapid advancement
  – (this was my path after UW)
Basic Corporation Finances

Revenue  money earned
– Expenses
= Income  profit

Top Line

• Almost every company loses money initially
  – new companies (“startups”) need to raise money

• Once you are profitable, you control your own destiny
  – non-profits usually raise money forever

Bottom Line
Sources of Funding

Two sources of funding

1. **Debt**: a loan
   - low up-side (fixed percentage)
   - debt holders have low risk tolerance
     - frequently want collateral to limit downside

2. **Equity**: exchange for part of all future profits
   - unlimited up-side
   - equity investors have high risk tolerance
Angel Investors

• Most risk-tolerant investors are “angels”
  – they invest when no one else will

• Thomas Edison’s story is widely known
  – invented the light bulb and electric lighting
  – took years of hard work
  – who paid for it?

• He had an angel investor
  – found more money each time Edison ran out
  – that part of the story is often left out
Funding Rounds

- Pre-seed: angels
- Series Seed: VC firms / angels
- Series A: VC firms / institutions
- Series B: …
- …
- IPO: public market investors
- Debt: banks / investors

• Each stage is less risky than previous
### Funding Rounds Sizes (Median)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-seed</td>
<td>hundreds of thousands</td>
</tr>
<tr>
<td>Series Seed</td>
<td>low single-digit millions</td>
</tr>
<tr>
<td>Series A</td>
<td>high single-digit millions</td>
</tr>
<tr>
<td>Series B</td>
<td>tens of millions</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

- **What if you’re not comfortable raising such amounts?**
  - there are ways to raise smaller amounts (more later)
  - you also might be misunderstanding the relationship between founders and investors
Raising Money

• An old saying in finance:
  When you owe the bank $100, that’s your problem.
  When you owe the bank $100m, that’s the bank’s problem.

• The bigger the check, the more they work for you
  – they don’t want to lose the money invested
  – they don’t want a bad result on their investment record
    • “an investment is an endorsement of that company as
      the winner in this space” — Secrets of Sand Hill Road

• VCs can connect you with customers, potential hires, potential new investors, etc.
Raising Money

• Expect to sell 20-30% of the company in each round
  – “dilution” of earlier investors
  – each round usually includes an option pool
    • used to hire & replenish the founders’ stake

• **Recall**: only need funding when revenue < expenses
  – paying customers reduce the need for more funding
    • also shows that you’re building the right product
  – can “self-fund” if expenses are low enough
    • friends & family are sometimes an option
    • some startups have skipped early rounds (e.g., [Calendly](https://calendly.com))
Company Stages (a16z)

- Pre-seed
- Series Seed
- Series A
- Series B
- ... 
- IPO
- Debt

Product stage
  - finding product / market fit

Growth stage
  - taking market share

Operations stage
  - improving margins & efficiency
Company Stages (a16z)

Pre-seed
Series Seed
Series A
...

Product stage
– finding product / market fit

• Founders of businesses raising Series A/B rounds…
  – will typically be millionaires on paper
  – will have lots of help from their investors

• Let’s just focus on the product stage
Series A/B Funding

• Established clear “product / market” fit (PMF)
  – lots of paying customers
    • e.g., $1m in annual recurring revenue
  – core group of customers that love the product
    • high engagement

• Raising money to switch into growth mode
  – hire more people to expand the product
  – spend on advertising and marketing
  – capture market share before bigger competitors arrive
# Pre-Seed & Seed Funding

<table>
<thead>
<tr>
<th>Funding amount</th>
<th>Pre-seed</th>
<th>Seed</th>
</tr>
</thead>
<tbody>
<tr>
<td>$500k – $1m</td>
<td>$2m – $5m depending on industry.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What you've shown</th>
<th>Pre-seed</th>
<th>Seed</th>
</tr>
</thead>
<tbody>
<tr>
<td>You've created a minimally-viable product that works in some way.</td>
<td></td>
<td>You've demonstrated some kind of product-market fit and traction.</td>
</tr>
<tr>
<td>You've identified a clear market and a pathway to that market with your product.</td>
<td></td>
<td>You've assembled a high-quality team to build out the company.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Normal valuation</th>
<th>Pre-seed</th>
<th>Seed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typically $1M - $3M, depending on industry.</td>
<td>Typically $5M - $15M, depending on industry.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target runway</th>
<th>Pre-seed</th>
<th>Seed</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 9 months</td>
<td>12 to 18 months</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Typical investors</th>
<th>Pre-seed</th>
<th>Seed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friends and family, accelerators</td>
<td>Angel and institutional investors</td>
<td></td>
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</tbody>
</table>

*from brex.com (numbers updated for 2022)*
Steps in the Product Stage

- Minimally-viable product
  - can raise pre-seed funding

- Some evidence of PMF / traction
  - can raise seed funding

- Clear evidence of PMF (e.g., $1m in ARR)
  - can raise series A/B funding

- Various forms of evidence of PMF
  - paying customers, waiting lists, letters of intent, etc.
Steps in the Product Stage

• Each funding round is to help get to the next round
  – have a plan for how the money will accomplish that

• External funding can start with pre-seed round

• Steps involved in pre-seed funding:
  1. find a problem worth solving
  2. identify customers willing to use minimal solution
  3. form a C corporation
  4. prepare a pitch to describe your product / business vision
  5. find investors who want to back you
  6. agree on funding terms with a “SAFE”
    • 5 pages, just two numbers to agree on
Pre-seed Pitch

• Can be live or recorded

• Questions from potential investors:
  1. Can you **ship**?
     • need to finish building the product
  2. Can you **sell**?
     • need customers who want to buy the product
  3. Can you **hire**?
     • need more than a few people to build most products
1. Can you **ship**?
   - need to finish **building** the product

• We spent the whole quarter talking about this!
  - writing high quality code
  - tools, inspection, and testing

• Pitch includes a demo that shows what you can do
  - you’ve just seen one!

• You also need product ideas & design
  - must ship a product that people want
Pre-seed Pitch

2. Can you **sell**?
   - need customers who want to buy the product
   - what **evidence** do you have that they exist?

- Get feedback
  - talk to potential customers & investors
  - code must work (correctness)

- Hard to get it right the first time
  - iterate! (changeability)

- How will you find paying customers?
  - have a plan to use the money for this
Pre-seed Pitch

3. Can you hire?
   - need more than a few people to build most products
   - do you have a story to convince others to join

• You are asking employees to bet on the company also
  - need to sell to them just as much as customers

• You will need more programmers (& designers etc.)
  - must contribute quickly (understandability, modularity)
  - have a plan to use the money for this
Preparing to Pitch

• Expect to hear a lot of “no”s
  – angel investors may pass on 24 out of 25 pitches
  – successful companies have had 100 “no”s before a yes
  – thousands of angel investors… only takes one “yes”

• Hard to know what a particular VC is going to think
  – a16z: “we invest in good ideas that sounds like bad ideas”
  – may like the team but not the idea or vice versa

• Why back this team going after this idea?
  – what is your personal connection to the problem solved?
More Help

• UW CoMotion
  – startup training
  – connections and mentoring
  – office space (part of their startup incubator)
  – grants based on impact and financial need

• CSE 599: Entrepreneurship (offered winter quarter)
  – co-taught by Greg Gottesman from PSL
  – PSL is a local startup incubator

• Angel investors in Gates & Allen
  – VCs down the street (e.g., Pack Ventures)
Think About It

• Never been easier to do a startup. Vs 40 years ago:
  – 100x more funding available
  – 100x less money required

• Startup / venture community
  – (naïvely) optimistic
  – supportive
  – VCs are happy to talk & help before you are ready to pitch

• Still many opportunities
  – one obvious area…
    • new business ideas any time expensive things become cheap
    • connectivity, wireless, parallel computing… now AI