How To Do Research

如何做学问

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Microsoft Research China

如何做学问

- 做学问的实质 The fact
- 做学问的乐趣 The fun
- 做学问的方法 The skills
- 做学问的技巧 The art
- 做学问的风格 The style
- 做学问的环境 The environment
- 做学问的标准 The standard
- 做学问的管理 The management

What Is Research?

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- Arch (研究方向)
- SeArch (具体课题)
- ReSeArch（解决方法)

做学问的三部曲

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- 昨夜西风凋碧树，独上高楼，望尽天涯路
- 衣带渐宽终不悔，　为伊消得人憔悴
- 众里寻她千百度，蓦然回首，那人却在灯火阑珊处

王国维《人间词话》

什么是基础研究

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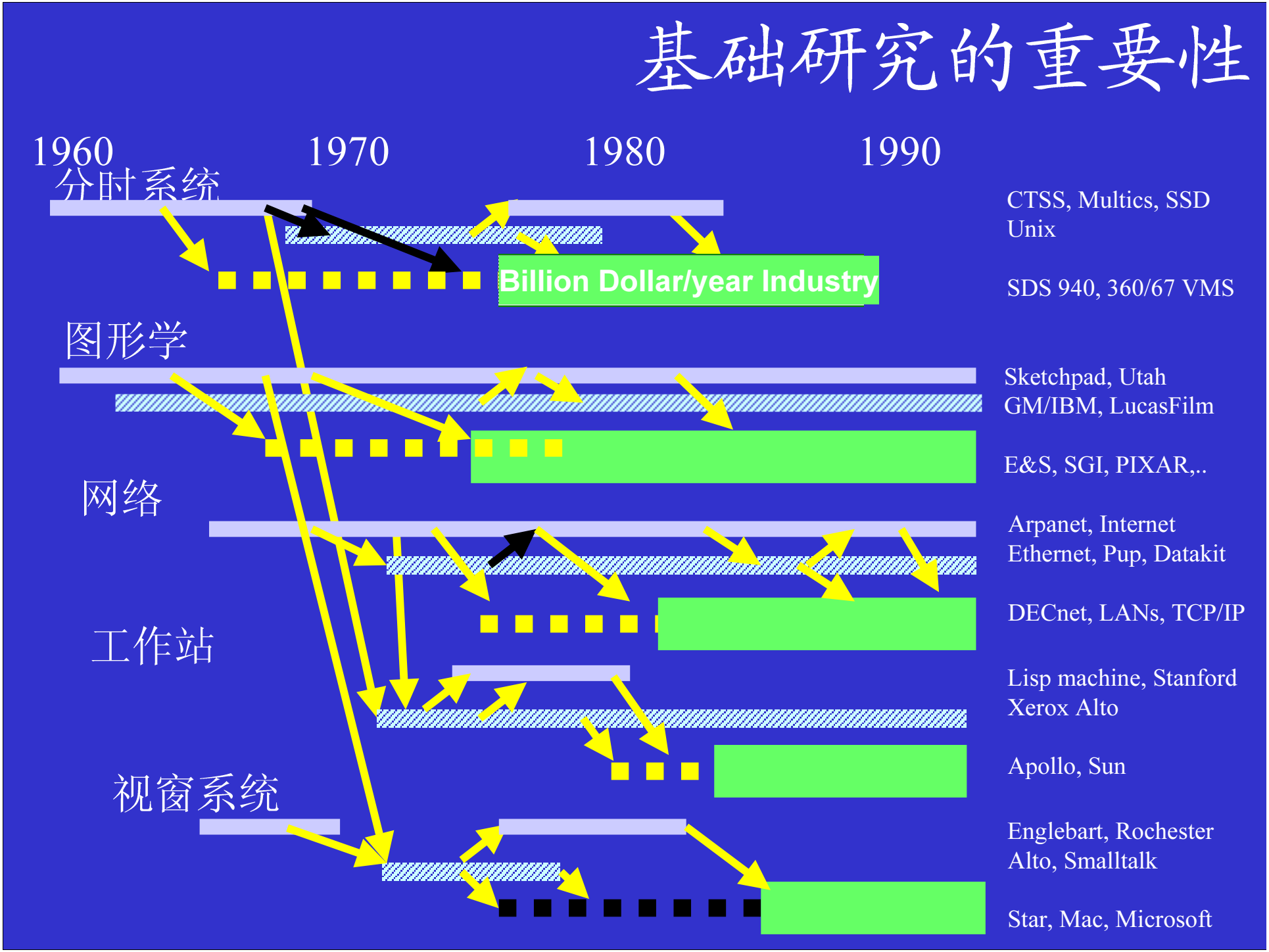
- 基础研究的定义
  - ✓ 不是为了今天的用户和产品。
  - ✓ 认定技术趋势，为未来的用户做的。
- 为什么要做基础研究？
  - ✓ 基础研究是对未来的投资：
    - 大风险、大回报。
    - 保险。
  - ✓ 今天的产品都是建立在过去的基础研究上。

基础研究的重要性


1960
1970
1980
1990
分时系统
Billion Dollar/year Industry
图形学
网络
工作站
视窗系统
CTSS, Multics, SSD Unix
SDS 940, 360/67 VMS
Sketchpad, Utah GM/IBM, LucasFilm
E&S, SGI, PIXAR,..
Arpanet, Internet Ethernet, Pup, Datakit
DECnet, LANs, TCP/IP
Lisp machine, Stanford Xerox Alto
Apollo, Sun
Englebart, Rochester Alto, Smalltalk
Star, Mac, Microsoft

The Fun

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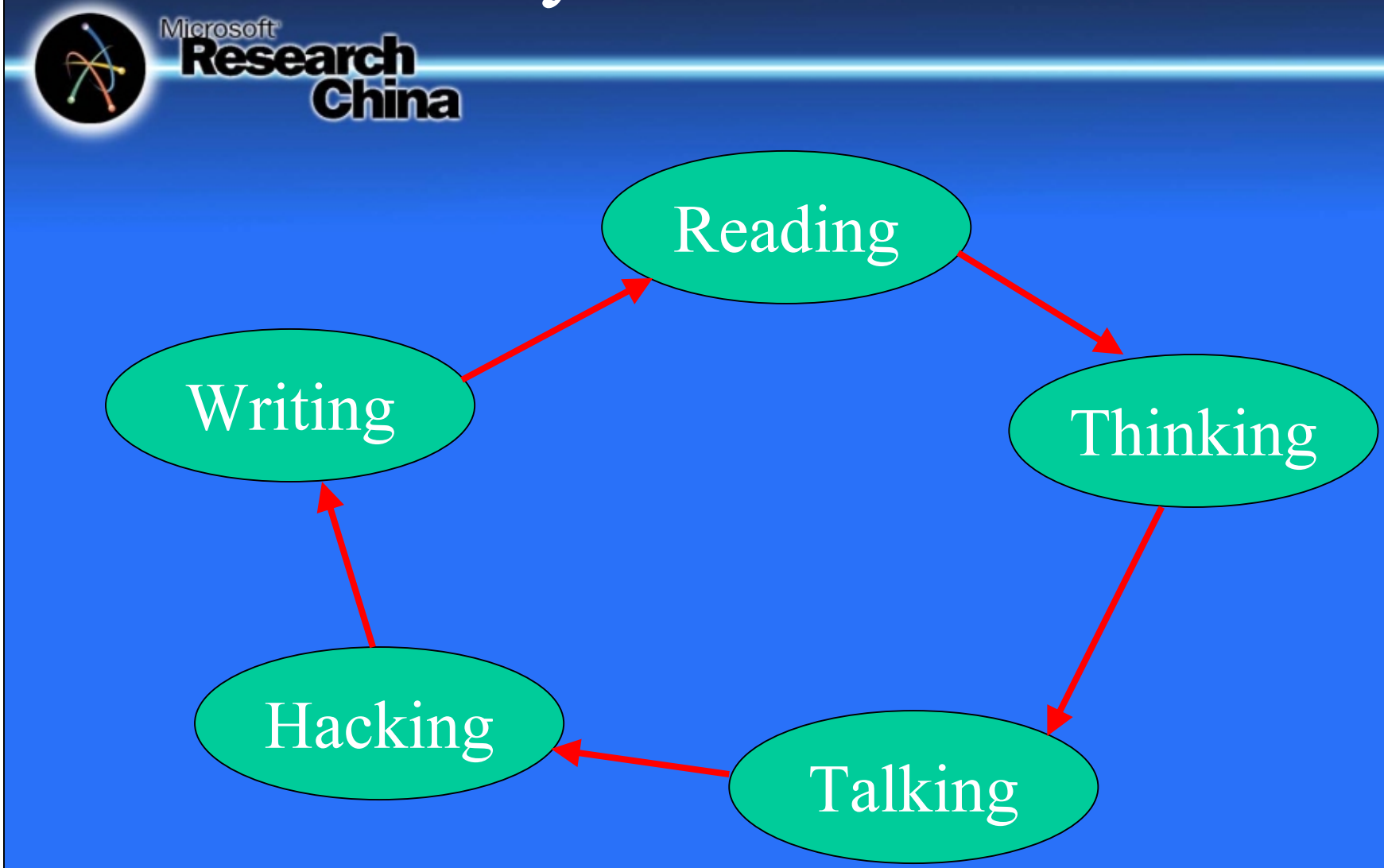
- Keep yourself motivated everyday
  - ✓ Believe in what you are doing
  - ✓ Be excited about your project
  - ✓ Find interesting people
- Research is NOT bigger than life
  - ✓ Have a life!

The Gist of Research: What's New?

- 一流高手提问题
- 二流高手解问题
- 三流高手抄问题
  - ✓ 小打小闹，炒冷饭

Daily Grind Of A Researcher



Happy Reading

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- Need to know the state-of-art
- Read a lot
- Read selectively
- Find the key ideas in the paper
- Understand the motivation of the paper
- Learn how to write a good paper

Finding A Good Topic

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- A real problem, not a toy problem
  - ✓ Topic connected to existing research
  - ✓ Topic related to products
- Significant, yet manageable
  - ✓ Solid theoretical work, or
  - ✓ Good empirical results
  - ✓ Or both

不清楚怎样做

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- 不是:
  - ✓ 重复别人的工作。
  - ✓ 做一件产品。
  - ✓ 做最热门的题目，无论它有没有研究价值。
    - （e-Commerce) “电子商务”
- 是:
  - ✓ 做前人未作过的工作。
    - “做完这工作，你应是世界之最的专家。”
  - ✓ 有相当的风险。
    - “如果你所有的项目都成功了，那么你就失败了。”

Style –Where Are Good Ideas?

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- The matrix approach 挖洞法
- Depth-first 枪扎一条线
- Breadth-first 棍扫一大片
- Representation, representation, representation 得奖之道，莫过于此
- Cross-disciplinary

- Hammer-and-nails

如何做好研究？

- Establish goals:
  - ✓ 有明显的有用、有利益回报
- Think simple:
  - ✓ 可简单、生动地描述研究问题
  - ✓ 分解为一些子问题、一一解决
- Hand-on:
  - ✓ Experiment and build prototypes
- Use scientific methodology and tools
- Collaborate
- Document results

简单、生动的描述

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- 不是：
  - ✓ “图形、图像学”、“语音”
  - ✓ “网络”、“多媒体”
- 是：
  - ✓ “让计算机能听懂任何人的语音”
  - ✓ “从照片推出三维环境”
  - ✓ “使多媒体的浏览和文本浏览一样简单”

科学的方法

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- 基础研究是：
  - ✓ 想着做事情。
  - ✓ 经过科学手段、大量的数据、可重复的深入研究。
  - ✓ 研究、理解、借用前人的结果。
  - ✓ 经过亲自设计工程原型，证实对用户有用。
  - ✓ 承认失败，从头开始。
  - ✓ 专家带头，副研、研习生学习。
- 基础研究不是：
  - ✓ 坐着想事情。
  - ✓ 肤浅的、无用的、无法扩张的简单结果。
  - ✓ 不看别人的研究，或只抄袭别人的研究。
  - ✓ 理论的、没用的纸上谈兵。
  - ✓ 不承认失败、永无止境的延续研究。
  - ✓ 博士生带头，本科生编程。

分为子问题、一一解决

- 浏览多媒体:
  - ✓ 多媒体 – 视频。 内容:
    - 视频 ->新闻。
    - 将来: 体育、音乐。。。
  - ✓ 浏览的前提:
    - 结构化。
      - 音频分析、语者分析、视频分析 – 压缩域。
      - 将来: 语音识别、人脸识别。
      - 如何把多元化结果结合?
  - ✓ 用户界面。
    - 电视用户、计算机用户的需求。

Hands-on

- Research is a process
- Hands-on coding and experiment of our ideas
- Experiment design and data collecting are important processes of research
- Junior students are extension of our team, but not …

Common Problems

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- Procrastinate …
  - ✓ If you don't do it, you never get there!
- Stop too soon …
  - ✓ If something works, must be a reason behind!
- No thesis
  - ✓ Focus on what's important

Talk Is NOT Cheap

- It is very important to communicate
  - ✓ Help you clarify what your idea really is
  - ✓ Get constructive feedback
  - ✓ Help you build critical skills
- Find sympathetic ears
  - ✓ Force your advisor/boss to listen
  - ✓ Listen to your colleagues

理想的工业界基础研究

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- 基础研究环境
  - ✓ 研究没有产品的压力。
  - ✓ 研究有产品的潜力
  - ✓ 最终，最重要的衡量时对未来产品的贡献。
- 基础研究的风气
  - ✓ 长远的眼光，但是5年是很短的时间。
  - ✓ 冒险的精神，但是不做没有希望的工作、不做对公司没用的、或影响力较小的工作。
  - ✓ 开放的环境，但是不是可任意做任何研究！
- 基础技术人员
  - ✓ 不应为今天的产品服务。
  - ✓ 但必须理解今天的产品、客户。

（在微软）有明显的利益回报：*将来的产品*

- 为什么在乎产品的影响？
  - ✓ 不申请经费的代价。
  - ✓ 证实基础研究的价值的机会。
  - ✓ 失败的惩罚是绝迹。
- 为什么要研究院？
  - ✓ 把握公司的长期方向
  - ✓ 对将来的产品和利润有贡献。
- 研究院长期的唯一成功是产品的影响.

成功的衡量

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- 微软的研究院的 6 ‘P’
  - ✓ People – 研究人才
  - ✓ Programs – 合作项目
  - ✓ Publications – 学术著作
  - ✓ Patents – 发明专利
  - ✓ Prototypes – 技术原型
  - ✓ Product Impact – 产品影响

Principles of Success

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- To hire the best people there are and have them do what they are good at
- But keep an eye on what's good for the Company
- Especially to see whether long-term projects also carry short-term benefits.

Comparison Among Labs

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- IBM and Bell Labs
- HP Labs: organized around business
- Xerox PARC: no product impact
- Intel/Sun/Siemens/Kodak …

- MSR is a best set up for CS research !

基础研究的人才

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- 基础技术人员的角色
  - ✓ 大方向必须信任基础技术人员。
  - ✓ 经营、产品不能靠基础技术人员。
- 基础研究的管理
  - ✓ 大方向的掌握：有用的基础研究！
  - ✓ 长期性的承诺。
  - ✓ 对项目负责人：引导、但不控制。
  - ✓ 对学习者：把负责人当榜样、学习。
  - ✓ 雇用最有才华的人。
- 基础技术人员
  - ✓ 不应为今天的产品服务。
  - ✓ 但必须理解今天的产品、客户。

中美人才的差别

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- 中国人才的特点
  - ✓ 敢冒风险
  - ✓ 有雄心壮志
  - ✓ 能学习、适应新环境
  - ✓ 实事求是的作风
  - ✓ 有克服困难的毅力
  - ✓ 扎实的理论基础
    - 尤其是数学
  - ✓ 很强的编程能力
  - ✓ 讲纪律、讲服从
    - 对较多事都没有主见。
    - 但是有想法不直说
- 美国人才的特点
  - ✓ 敢冒风险
  - ✓ 有雄心壮志
  - ✓ 能学习、适应新环境
  - ✓ 创新精神
  - ✓ 有热情、有主动性
    - 如果对问题有兴趣。
  - ✓ 独立从事研究的能力
    - 题目想的远、做的深
    - 对什么事都有主见
  - ✓ 直截了当的沟通
    - 甚至批评和争论

有希望的基础研究的人才

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- Aim your career at a well-know scientist in your field
- 深的研究、高的标准、科学的结果。
  - ✓ 为达到目标，不排斥任何工作（尤其编程）
- 热情 + 主动性 + 责任心。
  - ✓ 立定目标，刻苦地、有毅力地、自动自发地克服困难。
- 明确的目标、细腻的计划。
- 想什么，说什么，可以说不要。
  - ✓ 但是一旦接受、开始工作后必须讲纪律。

坚持最高的研究标准

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- Research on problems with potential high impact in the research field and/or high impact tech transfer
- 研究的目的不是:
  - ✓ 为了鉴定、拿经费、出论文、满足好奇心做的。
- 研究的目的是: make a difference in people's lives.
- 创新的定义是: Anticipate future user's needs and solve them with new ideas.

坚持最高的研究标准

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- Solid experiments on our ideas and algorithms, never fake
  - ✓ Solid experiment design
  - ✓ Solid experiment
  - ✓ Convince yourself first
  - ✓ Research is not for show
  - ✓ You are smart enough to do find non research jobs

坚持最高的研究标准

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- Target on most prestigious conferences and journals
  - ✓ Number does not count
  - ✓ Be referred is the measure
- Keep highest standard in paper writing
  - ✓ English is not the problem of preventing good papers
  - ✓ Seriousness is essential
  - ✓ Read it

坚持最高的研究道德标准

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- Never fake in experiment and over claim: research is not PR.
- No copy of other's idea
- Teamwork and collaboration
- Never double submit papers
- Always pay attention to IP & copyrights
- Always protect company's interests

Patenting in Research

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- Patents are an major part of a company's IP
- Keep your employer in an advantageous IP position
- Protect your employer's interest in the market place
- A major measure of our impact and success

Patent Filing: Processes

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- Write down clearly the idea as a pre-disclosure, and present to patent coordinator and your research manager
- Review importance of idea
- Meeting with patent attorney
- Following up with attorney in revising draft
- Sign off the filling

Patent Filing: Rules

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- Ideas with potentially high significance in product impact;
- Not obvious, no priori art, but avoid search
- Experimental testing not always necessary
- Patent is not a paper, only people who contributed to the ideas qualifies for an inventor

Protect Company IP, cont.

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- Protect others' IP:
  - ✓ Not bring IP (source codes) from previous job;
  - ✓ Be careful when using public domain code;
  - ✓ No public domain code in product
  - ✓ Don't ask/hire other companies' confidential information;
  - ✓ No illegal copy of software;
  - ✓ Be careful on copy right: be careful in using other's content

Summary:A Few Tips

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- Stay motivated
- Always ask “what’s new?”
- Focused on small ideas
  - ✓ Planning – daily, weekly, monthly
- But keep the thesis in mind
- Build a “buddy” system
- Patience

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Conclusion

Research is:

Striving to anticipate people's needs
results in great ideas and the world's best products

The Best Research Culture is:

Wake up every day with a feeling of passion for the difference technology will make in people's lives

-- Bill Gates