

CS137: Electronic Design Automation

Day 3: April 5, 2004
Concept Generation



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Today

- Specifications/requirements/goals
- Concept Generation

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Specification

- Before can start solving
 - Need to know what your solving
- Before can evaluate “goodness”
 - Need to know what trying to accomplish
 - Priorities

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Quantitative Specification

- Typically need to
 - turn vague specification
 - into something quantifiable/measurable
 - Something concrete

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Specifications

- More of a trick/challenge for things that don't have natural metrics
 - From:
 - Door closes easily
 - To:
 - Door latches with <5 lbs. Of force...
 - From: reliable
 - To: 1 failure in 10^9 hours of operation
 - 1 undetected failure ...

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Our Specifications

- [talk about]

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Establish Priorities

- Which requirement is king?
- Which have flexibility?
 - Can tradeoff?

Establish Targets

- Acceptable Ranges
- Ideal

- Usually Relative to alternatives/competitors

Our Targets and Priorities

- [sketch]
 - Delay in Solution
 - Area of logic in Solution
 - Energy of Solution
 - Reliability of Solution
 - Runtime of algorithm
 - Area for hardware engine to solve problem
- Problem formulation should capture priorities

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Concept Generation

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Goal of Concept Generation

- Fully explore design space
 - Not miss options
 - Open minds to possibilities
 - Know what can do
 - Competitors can do

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Components

- Structured Approach
- Partial Solutions
- Uncertainty/Unknown
- Documentation

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Non-Atomic Insight

Nothing will ever be attempted, if all possible objections must be first overcome.

--- Samuel Johnson, 1759.

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Uncertainty

“Do you remember what I have taught you?
Most intelligent beings prefer to live in certainty than uncertainty.
Rather than accept uncertainty, they will discount the input of
their own senses. It is through this mechanism that mages
manipulate the perception of others.”

--- Elric to Galen upon his [Elric's] death

Invoking the Darkness, Jeanne Cavelos

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Concept Generation: Steps

- Start refined problem specification
 1. Clarify/decompose
 2. Search
 - Externally
 - Internally / brainstorm
 3. Explore Systematically
 4. Reflect

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Decompose

- Separate components must solve
 - Divide and conquer
- Maybe attack w/ separate passes through process
- Focus on bottleneck
 - Critical path/subproblem
 - Where most risk is
 - Most innovation needed

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Search Externally

- Literature
 - Published / library / IBID
 - Web
 - Patents
- Customers
- Experts
- Benchmark related / competitive
- Understand state-of-art

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Search Internally/Brainstorm

- Common bugs:
 - Reject things too early
 - “Nothing...” quote
 - Latch onto few ideas
 - Get stuck in own local minima

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Search Internally/Brainstorm

- Different mode of thinking
- Generate lots of ideas
- Suspend judgment / no squashing
- Barr: grow mode / acid mode
- Find good pieces, incomplete ideas
- Wishful thinking
- Comfortable with uncertainty

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Brainstorm

- Throw out ideas
- Write them down ... draw pictures
- De-personalize
 - Name by characteristics not person
 - Not attacking person/idea
 - Group ownership
 - Everyone contribute to debugging
- Mix-and-match
- Good science
 - Find best ideas, avoid NIH

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People and Brainstorming

- More brains generally good
 - Maybe limit size of group at a time
 - Different perspectives good
- Group ownership of final product
 - Involve stake holders
 - Build confidence in conclusion
 - Get buy in

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Systematic Exploration

- Parameterized Design Space
- Concept combination matrix
- Classification tree
- Goals:
 - Find holes
 - Over-emphasis
 - Make sure think about all cross products..

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Reflect

- Really throughout
- Comfortable solving problem?
 - Specification adequate?
- Process

Time Permitting

Discuss

- Assumptions
- Refine/elaborate specification
- Decompose problem