**DESIGN FOR X**

- Design system/protocols/guidelines to optimize a design for a specific purpose

- Design guidelines propose an approach to control, improve or invent characteristics

DESIGN FOR TEST/REPAIR/DEBUG

- Design to maximize testability of a circuit

- Observability/Detectability: How internal states can be inferred by external outputs

- Controllability: Ability to move a system around whole state space with only certain allowed manipulations

- Functional v. Structural DFT  
- Automatic Test Pattern Generation (ATPG)

- Fault activation

- Fault propagation

- Stuck at fault

- Transcription?

- Translation?

- Protein – DNA?

DESIGN FOR ASSEMBLY

- Assemble with certain things in mind

- Testable intermediates

- Size

- Steps

- >2 parts in a one-pot reaction

- Ability to manipulate

- Assemble extra parts

- Optimizations

- Testable intermediates

- Fewest reactions

- Flexibility of additions (multi vs. single plasmid)

- Reusable intermediates

- Large/small plasmid size

- NAR Paper – Algorithms for Automated Assembly

- 6 Plasmid types: A, C, K, A/C, K/C, K/A

- MoClo would need completely new set of restricitons

- 2ab method takes advantage of lack of gel purification steps

- Reusability vs. Non-reusability

- Stages = time, Steps = wet-lab

- Cost function = <stages, steps>

- Trade off between stages, steps

- Other parameters possible

- Total number of assembly trees = 2n!/(n+1)!n!

- Naïve algorithm looks at all possibilities, selects the lowest cost

- If n = power of 2, one optimum assembly graph

- min(stages) = log2(n), min(steps) = n-1

- cost = <log2(n), n-1>

- Optimal substructure true for a stage/step based on cost function, but not necessarily true for all possible cost functions

- Optimal substructure property still true when using a part library

- Optimal substructure allows us to calculate cost for an intermediate part once and then re-use the calculation

- Intra-GPS violates optimal substructure property

- Unlike intra-GPS, inter-GPS guaranteed to reduce the number of steps w/o increasing assembly stages

- Slack factor = local optimum stages – max stages(all goal parts)

- Even w/ slack factor and sharing, no guarantee that single-goal-part algorithm will choose graphs with max(shared intermediates)

- Solution = iterative refinement

DESIGN FOR CHARACTERIZATION

- Invert FPs, other characterization parts

DESIGN FOR RECONFIGURATION

- Reconfigurability

- Invertases

- Other recombinases

- MAGE?

- Other mechanisms

BUILT-IN SELF TEST (BIST)

- BIST to meet requirements such as high reliability/low technician assembly

- BISTs are generally used to reduce circuit complexity

- Logic BISTs (LBIST) are when hardware/software is built into the circuits

- LBIST to test internal circuits w/o connection to external nodes

RANDOM NOTES – GROUP FEEDBACK

- Automatic placement of FPs

- Automatic restriction mapping

- Automatic robot input testing

- Design for Repair PCR (Primer design)

- Primer site design (sequencing)

- Single/Multiplasmid

- Eugene rules against assembly

- Design for Characterization 🡪 plasmid copy count

- Small molecule limits

- Restriction sites (add/remove)

- Design for Reliability

- Double-terminators

- No registry parts

- No iGem parts

- Design = set (RBS/Promoter options)

- Feedback

- Recycling library

- Time metric

- Retroactivity

BIOMECHANISMS

- Antibiotic resistance

- R/W & B/W screening

- Spacing (RiboJ sites?)

- Invert

- Excise

- Insert

- Substitute

- Promoter tuning

- RBS tuning

OTHER NOTES

- Other assays

- Quantum dots (Columbia/Cooper iGem, Ting (MIT))

- Sequencing

- Metrics

- Coverage (DFT)

- Trade offs (redo v. manipulate)

- Cost

- Time

- Start with small examples, practice design approaches