A fast walk through some Work in Progress

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joint work with many many people

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Generating Game HUDS - Manivanna Thevathasan

Fitt's Law: $\mathtt{ID} = a + b \ln(A/D + 1)$
(selection/pointing difficulty)

Genre: Tower Defense
Given (in a DSL):

- Model of player tasks
  - What does the player need to know
  - What does the player need to do
- Size of screen

$\Rightarrow$ generate an *optimal* HUD layout.

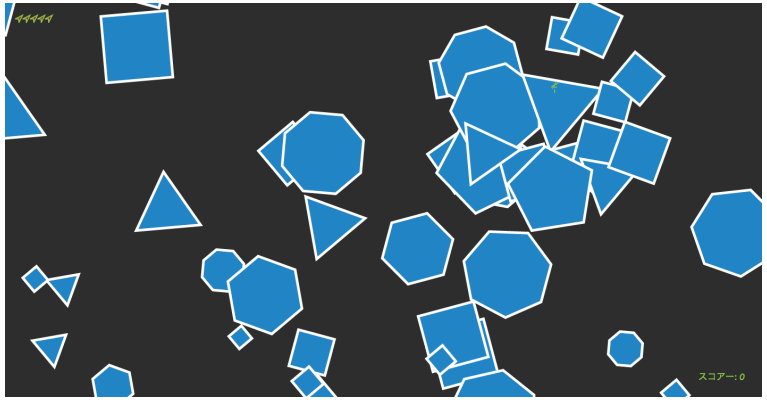
Non-linear optimization problem.

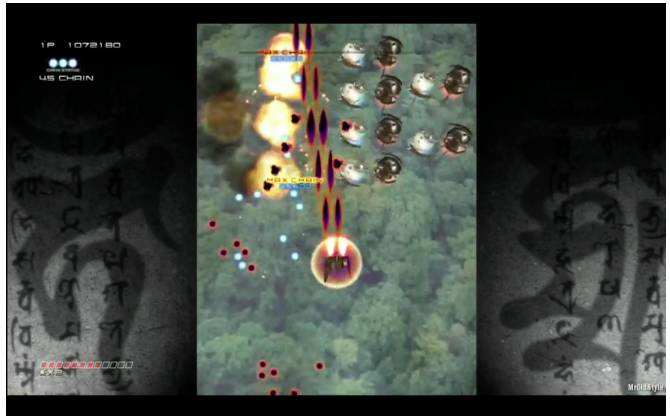
The *Bullet Hell* Program Family - Nathan Collman

Declarative DSL of design choices

```
elements
  protag
    name "bossProtag"
    control wasd
    movement
      type plural
      rotation
        direction acw
        speed f
```

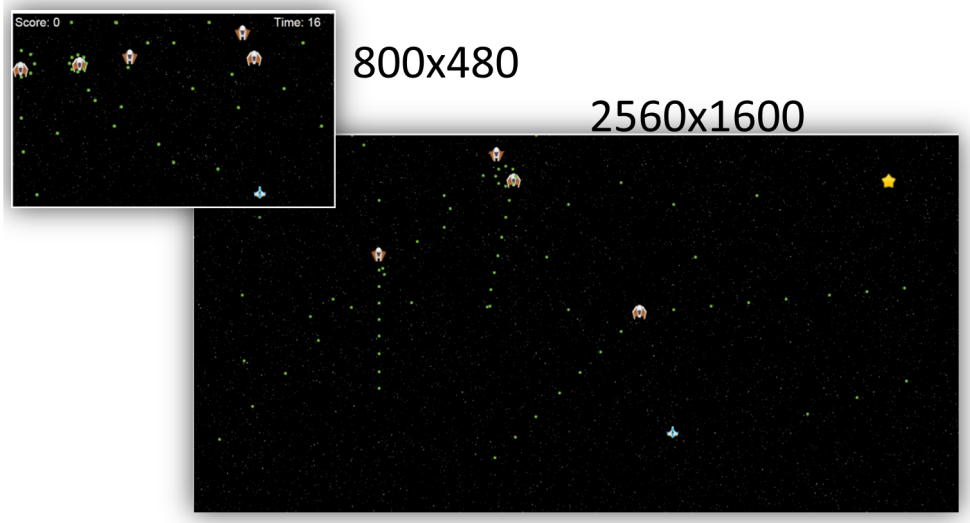
Javascript-Crafty-HTML5 generator





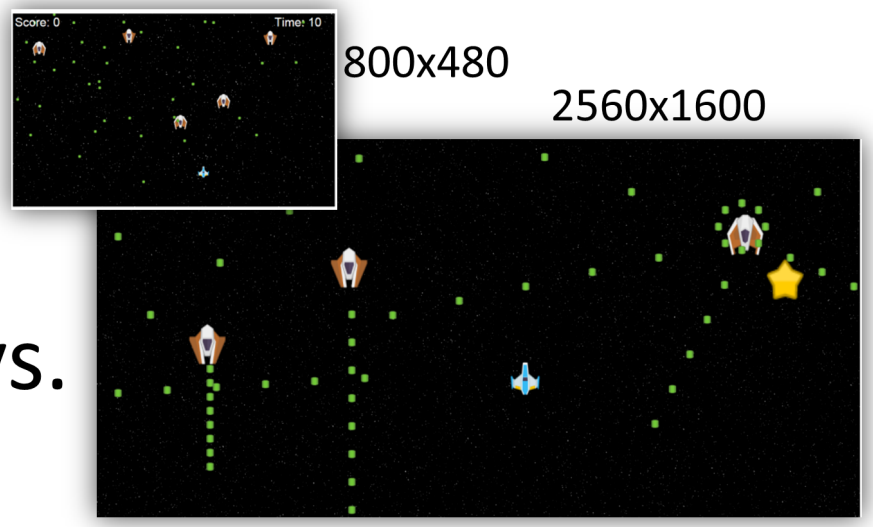
Scaling experiments - Robert Teather

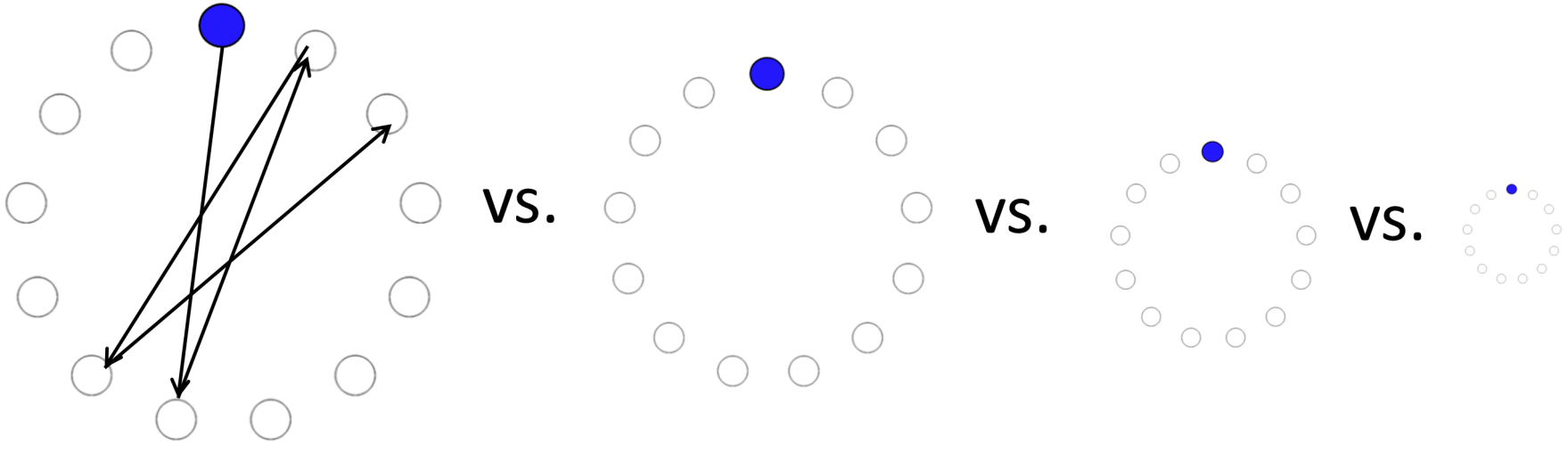
Non-Uniform Scaling



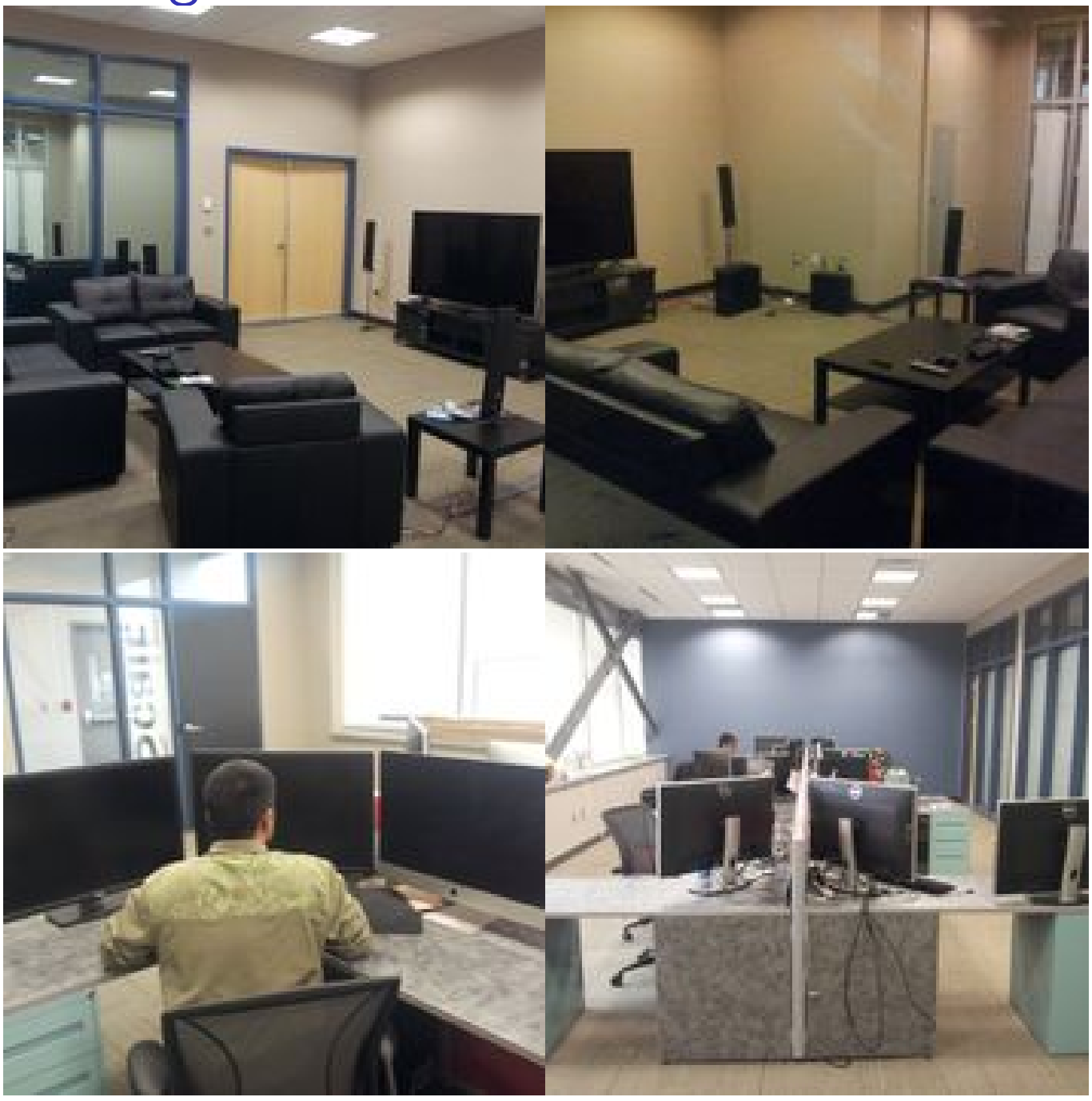
vs.

Uniform (Standard) Scaling





Scaling lab - Andrew Mactavish



GenCheck - Gordon Uszkay

https://hackage.haskell.org/package/gencheck
or https://github.com/JacquesCarette/GenCheck

Strategy language and combinators for property-based testing.

A (new) single framework which

- combines QuickCheck, SmallCheck, FEAT, EasyCheck
- adds more strategies; guarantees uniform distribution
- allows arbitrary combinations of strategies
- modular: separates generation, test scheduling, reporting

Based on combinatorial enumerations from the theory of species.

```
propRevRevEq :: Eq a => [a] -> Property [a]
propRevRevEq xs = (reverse.reverse) xs == xs
deepReport (propRevRevEq :: Property [Int]) 100
```

Example testing strategy: exhaustive until depth 4, 100 random tests at depths 5-20, 20 *extrema* checks at depth 250.

Theory of data structures - Brent Yorgey (UPenn)

From memory allocation to Functor categories

Given:

- a theory of locations - category $\mathbb{B}$ of finite sets and bijections,
- a shape - a Functor $F : \mathbb{B} \to \mathtt{Set}$,
- induce a data-structure: $\tilde{F} : \mathtt{Set} \to \mathtt{Set}$ via the coend $\tilde{F}\ A = \int^L F\ L \times Hom(L, A)$ (an analytic Functor)
- by parametricity, that coend is really an existential quantifier
- encompasses all inductive types, plus Bags, Cycles, ...
- $\tilde{F}(A, L) = F\ L \times Hom(L, A) \Rightarrow$ arrays, finite map, hash tables, etc.

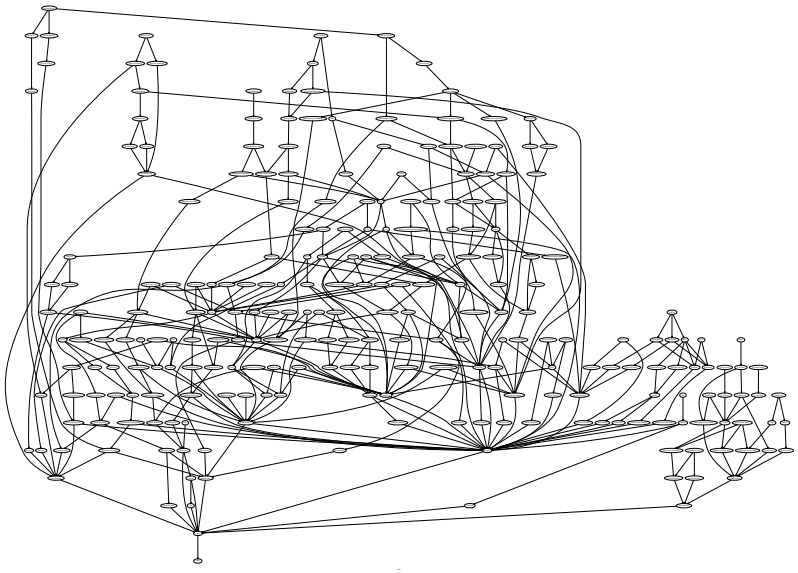
To get a better theory of memory allocation:

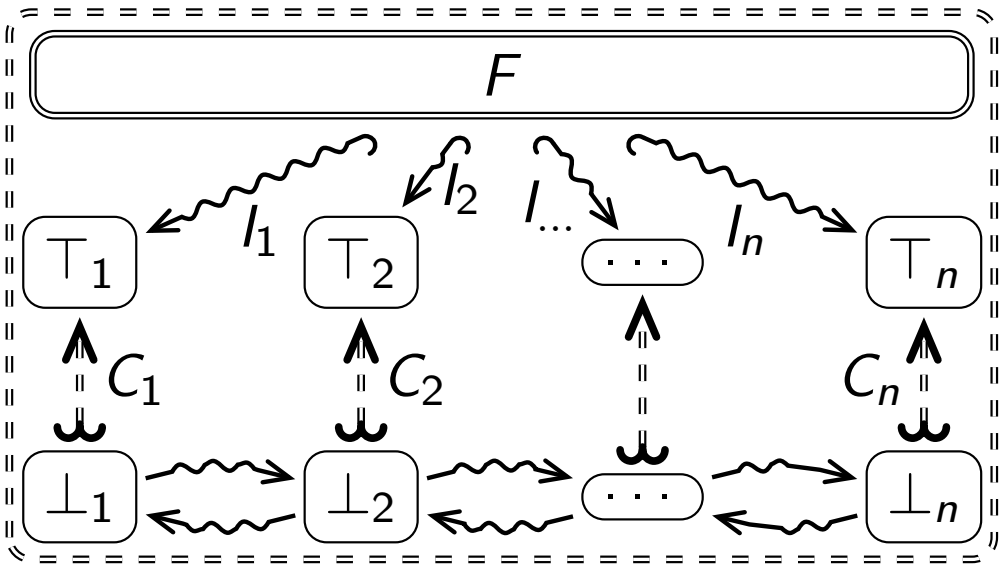
- switch to $F : \mathbb{B} \to \mathtt{Vect}$ and $\tilde{F}A = \int^L F\ L \otimes [L, A]$.

Haskell and (partial) Agda code at
https://github.com/byorgey/labelled-structures

Realms - William Farmer, Michael Kohlhase (Jacobs U.)

Setting: module/functor signature, trait, typeclass, or theory combinators.
Problem: organizing equivalent formulations and conservative extensions.





Examples:

- Monads via bind or join.
- S4 logic: 28 equiv. presentations

```
sequence_ :: Monad m => [m a] -> m ()
sequence_ = foldr (>>) (return ())
```

Morsels I

Typeclasses for models of computation - Lijun Zhu

Goal: unify presentations of *models of computation*.

Method: Create Haskell classes (and instances) for the concepts

Results: No surprises, but the details are fiendishly tricky.

Reversible Computation, funky types - Amr Sabry, Zach Sparks (Indiana)

- univalence theorem for language Π of the semigroup of types
- negative types, ring of types (interp: time-travelling transactions)
- fractional types, field (or meadows) (interp? pattern match)

HMM code generator - Dan Szymczak

DSL for HMM designs, codegen in Haskell, produces C

Morsels II

Geometry library generator - Spencer Smith, Yuriy Toporovsky

Tagless-final style generating extension for a family of geometry libraries.

Analysis of software engineering qualities - Spencer Smith, Adam Lazzarato, Yue Sun, Zheng Zeng, Vasudha Kapil

Analyse $4 \times 2 \times 30$ softwares in 4×2 application areas for *state of the practice* SE processes.

Symbolic simplification of PDFs - Andrew Leung, w/ Ken Shan

Requirements analysis for Mechanized Mathematics Systems - Yasmine Sharoda, Bill Farmer

Trustable Communication between MMSes - Mohammed Zayed, Bill Farmer

Morsels III

Repository of Knowledge on Software Certification - Ishwaree Argade

Comparison of Symbolic Modeling Systems on Automotive Applications - Alexander Schaap, Mark Lawford

Property-based testing for Hybrid Systems - Manas Ghosh, Mark Lawford

Analysing the suitability of HUD widgets for a variety of tasks - Margaree Peacocke

Scaling of UI for Starcraft II - Sal D'Amore

Literate Software tools - Ned Nedialkov, Spencer Smith