Lecture 15: Running Practice

cs1120 Fall 2009
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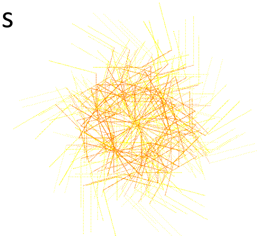
Menu

- Any Questions from Last Week?
- Exam 1
- Practice Analyzing Procedures
- Finest Fractalists



Sunburst
by **Erika Crawford**

Exam 1

- Handed out at end of Friday's class, due at the beginning of Wednesday's class
- Open non-human resources except for Scheme interpreters but no help from other people
- Covers everything through this Wednesday including:
  - Lectures 1-16, Course Book Chapters 1-8, PS 1-4
- Sample exams from previous years: if you can do well on Spring 2009 Exam 1, you should do well on our Exam 1 (of course, questions will be different!)
- Review Session, Wednesday 6:30 in Olsson 001

Running Time Practice

From ps3:

```
(define (flatten-commands ll)
  (if (null? ll) ll
      (if (is-lsystem-command? (car ll))
          (cons (car ll) (flatten-commands (cdr ll)))
          (flat-append (car ll) (flatten-commands (cdr ll))))))
```

What is the asymptotic running time of **flatten-commands**?

First: determine running times of all the procedures applied in flatten-commands.

Flatten Running Time

From ps3:

```
(define (flatten-commands ll)
  (if (null? ll) ll
      (if (is-lsystem-command? (car ll))
          (cons (car ll) (flatten-commands (cdr ll)))
          (flat-append (car ll) (flatten-commands (cdr ll))))))
```

First: determine running times of all the procedures applied in flatten-commands.

null?, **car**, **cons**, **cdr** – we already know there are constant time

What about **is-lsystem-command?**

is-lsystem-command?

```
(define (is-lsystem-command? lcommand)
  (or (is-forward? lcommand)
      (is-rotate? lcommand)
      (is-offshoot? lcommand)))
```

or is a special form:

OrExpression ::= **(or** *MoreExpressions***)**

To evaluate **(or** $Expr_1$ *MoreExpressions***)**:

1. Evaluate $Expr_1$.
2. If it evaluates to a non-false value, that is the value of the or expression. None of the other sub-expressions are evaluated. Otherwise, the value of the or-expression is the value of **(or** *MoreExpressions***)**

The value of **(or)** is false.

is-lsystem-command?

```
(define (is-lsystem-command? lcommand)
  (or (is-forward? lcommand)
      (is-rotate? lcommand)
      (is-offshoot? lcommand)))
```

is-lsystem-command? has constant running time: it involves applications of at most three constant time procedures.

```
(define (is-forward? lcommand)
  (eq? (car lcommand) 'f))

(define (is-rotate? lcommand)
  (eq? (car lcommand) 'r))

(define (is-offshoot? lcommand)
  (eq? (car lcommand) 'o))
```

Each of these procedures has constant running time: they involve only applications of constant time procedures **eq?** and **car**.

Flatten Running Time

From ps3:

```
(define (flatten-commands ll)
  (if (null? ll) ll
     (if (is-lsystem-command? (car ll))
         (cons (car ll) (flatten-commands (cdr ll)))
         (flat-append (car ll) (flatten-commands (cdr ll))))))
```

First: determine running times of all the procedures applied in flatten-commands.

null?, **car**, **cons**, **cdr**, and **is-lsystem-command?** are constant time

Running Time Practice

Remember: we care about the size of the input.

Introduce variables:

N_1 = number of elements in first input list (lst)

N_2 = number of elements in second input list (ll)

```
(define (flat-append lst ll)
  (if (null? lst) ll
     (cons (car lst) (flat-append (cdr lst) ll))))
```

What is the asymptotic running time of **flat-append**?

Other than the recursive call, each execution is constant time:

null?, **car**, **cons**, **cdr**, are constant time

How many recursive calls are there?

N_1 (the number of elements in the first input list)

What is the running time?

The asymptotic running time of flat-append is in $\theta(N_1)$ where N_1 is the number of elements in the first input.

Note: **flat-append** is the same as **list-append**! (Stupid to define this as a separate procedure and name it **flat-append**.)

Flatten Running Time

```
(define (flatten-commands ll)
  (if (null? ll) ll
     (if (is-lsystem-command? (car ll))
         (cons (car ll) (flatten-commands (cdr ll)))
         (flat-append (car ll) (flatten-commands (cdr ll))))))
```

First: determine running times of all the procedures applied in flatten-commands.

null?, **car**, **cons**, **cdr**, and **is-lsystem-command?** are constant time

flat-append has running time in $\theta(N_1)$ where N_1 is the number of elements in the first input.

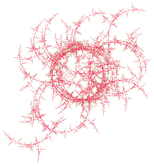
Second: determine running time for each application **except** for recursive call.

Need to consider both paths:

```
(if (is-lsystem-command? (car ll))
      (cons (car ll) (flatten-commands (cdr ll)))
      (flat-append (car ll) (flatten-commands (cdr ll))))))
```

Paths to Flattening

```
(if (is-lsystem-command? (car ll))
   (cons (car ll) (flatten-commands (cdr ll)))
   (flat-append (car ll) (flatten-commands (cdr ll))))))
```



Teamwork by
Rose Cunnion and
Lucy Raper

Each recursive call involves $\theta(P)$ work where P is the number of elements in (car ll).

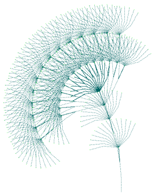
Each recursive call reduces the number of elements in ll by one.

For input list that is all lists of length P:
flatten-commands has running time in $\theta(QP)$ where Q is the number of sub-lists (of length P) in the input list.

to be continued Wednesday...

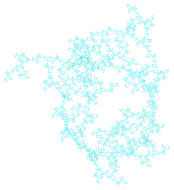
Fractal Finalists

Blowin’ in the Wind



1

TwistOnTiffany’s



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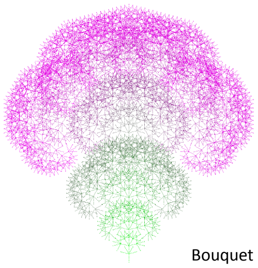
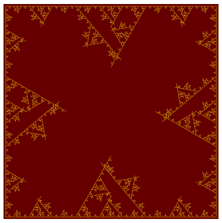
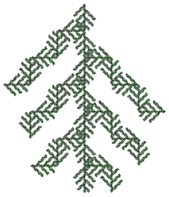


Bouquet

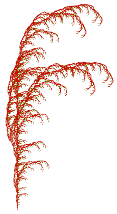
3



4 CrissCross

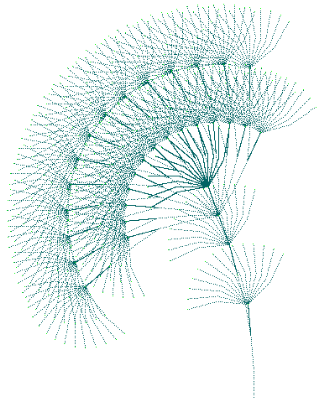


5 Ascension

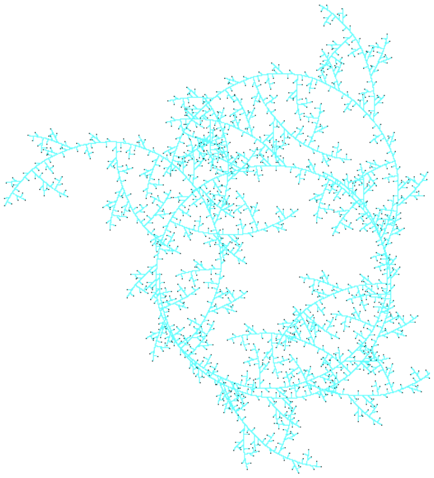


August Wheat

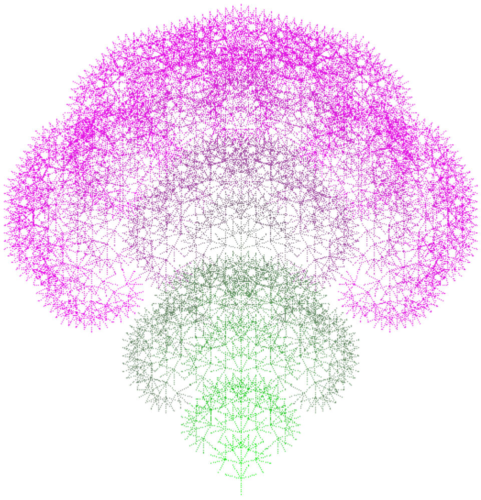
6



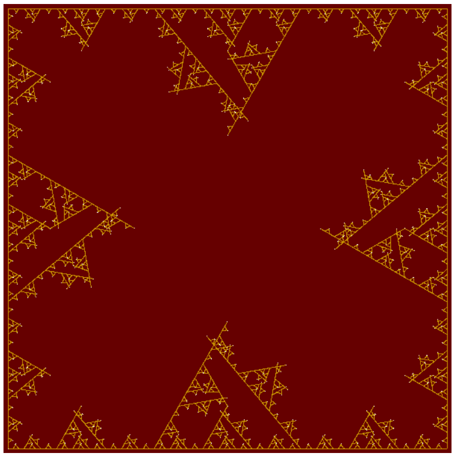
Blowin’ in the Wind



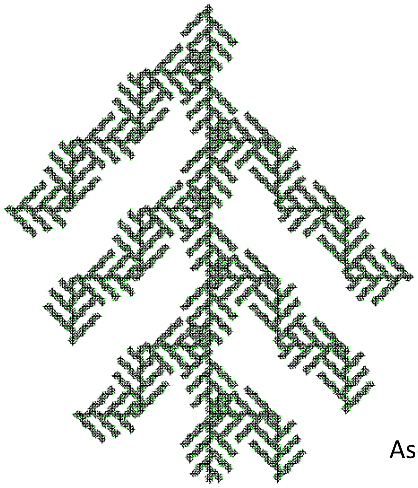
TwistOnTiffany’s



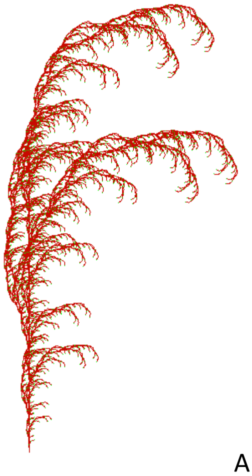
Bouquet



CrissCross

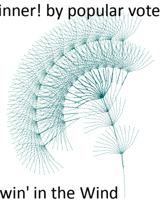


Ascension

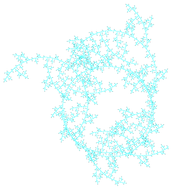


August Wheat

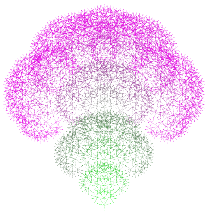
Winner! by popular vote



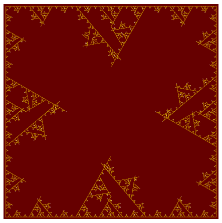
Blowin' in the Wind
by **Ian Nathan**



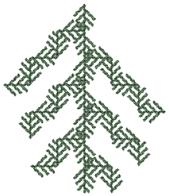
TwistOnTiffany's
by **Brittney Blanks**



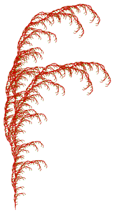
Bouquet
by **Richard McPherson**



CrissCross
by **Trygve Loken and Andrew Crute**



Ascension
by **Siddharth Rajagopalan**

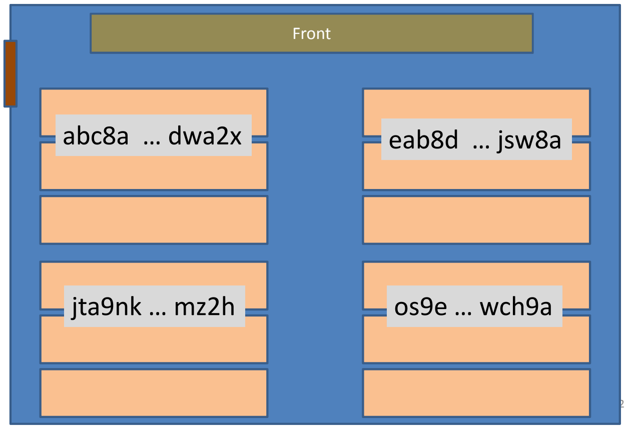


August Wheat
by **Melissa Bailey**

Charge

- PS4 is due Wednesday
- Exam 1 is out Friday, due next Wednesday
- Exam Review, Wednesday 6:30 in Olsson 001

Returning PS3



Front

abc8a ... dwa2x

eab8d ... jsw8a

jta9nk ... mz2h

os9e ... wch9a