# The 11th White House Papers
# Graduate Research in Cognitive and Computing Sciences at Sussex

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Fabrice P. Retkowsky

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## Cognitive Science Research Papers

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A

n o n v n g n n

A s o orns s s no r ro wrs s n ww b n s–

## on n

n B n n

b s n o b n n s on’ o b n
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n w

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vo ro s o r o n on o s ---------------------------- 1

Ann

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s n b n oo s ---------------------------- [illegible]

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n n o n r n or Dr n s ----------------------------

v

A opo s s n r ----------------------------

n Dv

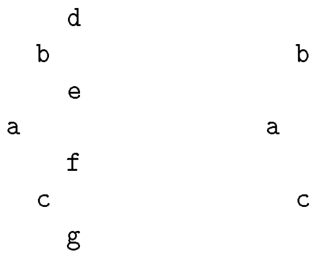
E o oo on A ss b o sons
os or F r E n s pp n
An App on o A b r s s o orr b s ss s ----------------------------

o ons ns ss ro E _'s s or bo s s ss n on r q r s p r
n n n n ron n –E sn' p r or no n ons o r s n o r n ron n o

**A problem descriptor** n r s s or s r p or or s p r b s on vor n r pr s n on o prob n p r on v b s n rn r n r s vor n r pr s n on–

**A bias pool manager** ss s r n n prob s n pp s rn rs n b s poo o s prob s or n o rn n ss r– r n n prob s r ss n r s o os r b s or n s o or n on b s v s r n r s o s p – – s – o s – o – p– – –

o ow n wo r s s p o n r sp –



**Homogeneity:** n b ro s b r s p –

**Balance of the tree:** n poss b s or ( ) ( ) s

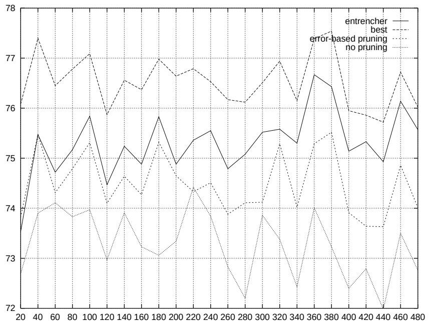
$$( ) = *$$

v r s n b ro s o rs n s o so r – b n s n s r b o ow n s or poss b s or ( )

$$\sum_{=} ( ) o_{(()()()())}$$

prob s r por n r n – – n or n r b s o prob s r r poss b ss ons–For rr n p r n s n b r o ss ons r os n n prob s o pos b r n n n s s s r ons r or ss on– rn n s s s r n on n n r s n n b r o prob s n s on r n s s s o prob s–

r or s pop r n spr b s n r poss b pr r s p s po s s– n n on s bo s n s s n n o pp o s p o b n r n rn s– n n ro n s o r or on so sor


entrencher
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error-based pruning
no pruning
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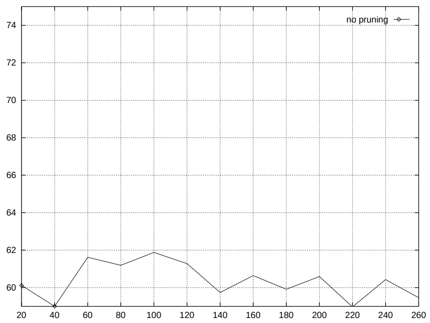
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480


no pruning
74
72
70
68
66
64
62
60
20 40 60 80 100 120 140 160 180 200 220 240 260

## n on

np r pr s n on o prob ss n n n s o r rn n p r or n Cr n & – n rn n b s s n r pr s n ons oo o n o or s b n p n n n ppropr s r s o pro np s r p on o prob s rn n b o s s r or n b s– s or s o n on s p r o rn n pro ss s n b r np r pr s n ons p o r ro n r on b y n prob n rn r s n & C o n & s – rn rs b o s r or r n np s r p ons r o n ons r rn rs– Cons r n on s nowy o on s r o pro rn n p r or n s on n s s b o r s r b prob s o n n r s C ns on o rn n s s –

n s p p r s ons r r n s r s or r b on or o ons r n on– n n n o s s r r pr s n s b n n y r b s s s o

ÊE E GÊ n o oos b n ons r ors n s p b s n rn r no r b – no n r b s n o b n or n r pr s n on o prob s ons r o b s non o s n ons r ors o pro –

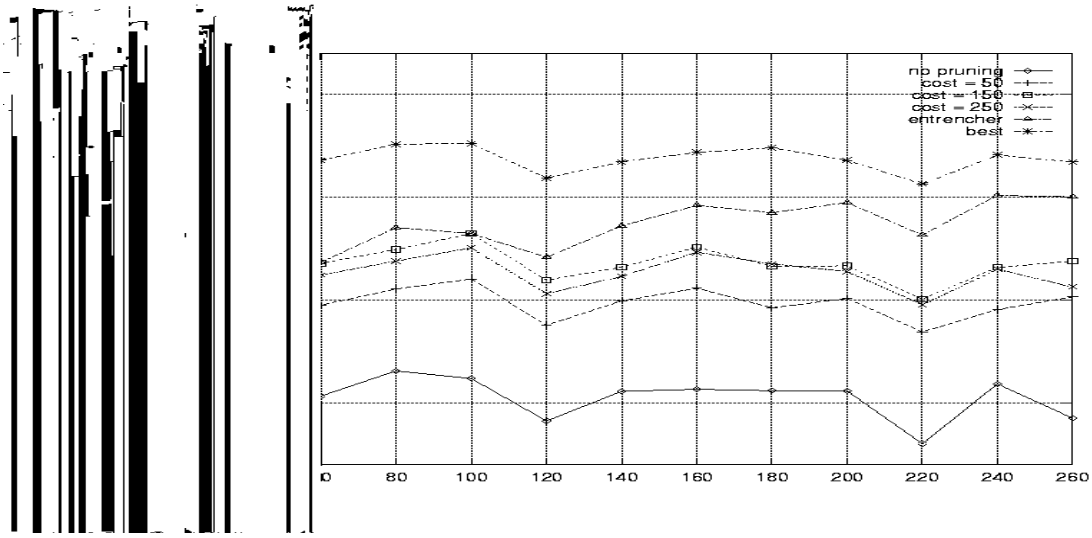
o s r r o prob s n n o o no p r s o n ons r or n r n r b s b b ons r or pro o rn n s r o s – o rs prob n n o o n o p r s o or n on ons r or–

## nn on

For s p r n s ACE ss ons s n o n r prob s o n o o n o p r s o ons r or r n r – For ss on prob s r n n ns n s r n r – r or n o ons r ors r s r n s s o pos o o ss ns n sp ns n s – rn n s s s r n on n n r s n n b r o prob s n n s on non o r pp n s s s o prob s– p r or n s s n o p r o b s poss b b s n ons r or poo – r s b or s s r n s s s n s r pr s n s r n n s s s– n n po n r pr s n s r o r ns n r r n n s s –

o s n r r o r ps b n o ns o p r s r n o p r or n b n b s n s on b s ons r or b so s s no r s n s s or ÊE E GÊ

s n ns n ɓ no – rn n n r or ɓ s n s or r n n rn n
ro E _’s n on r n o n or n on o _’s s –


no pruning
cost = 50
cost = 150
cost = 250
entrencher
best
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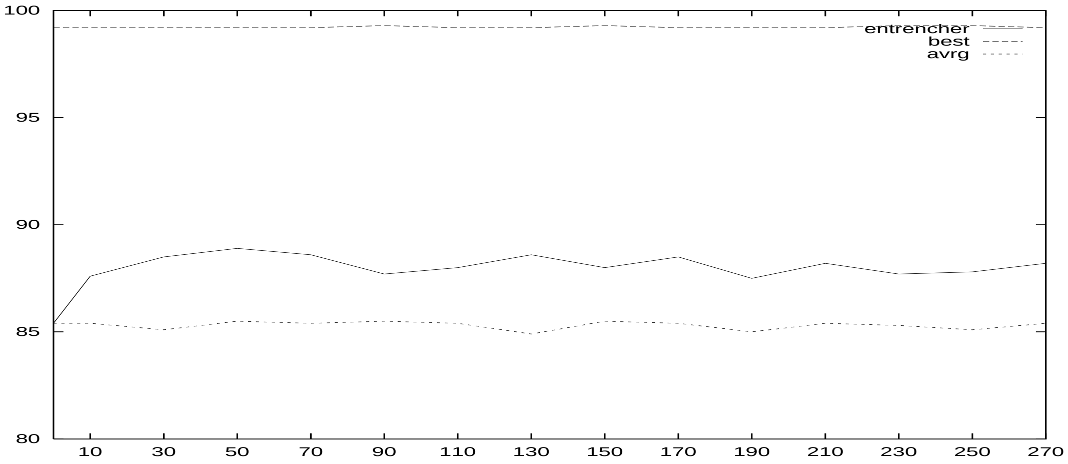
260

[illegible]


100
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entrencher
best
avrg

**n**

B ns s n – Co o sn’ v s s v _’s or rn n v n n ov o pr n –
n C– o ro C– E s–
pp– B r n– pr n r–

B ns s n – s – – rn n o rn boo n s s b s on r s r p ors– n
o r n – – r – E s–
pp– r C p b –

B r A– E r n A– ss r D– r – – rn b n pn
C r on n s ns on– –

B r A– E r n A– ss r D– r – – – _’s r or–
*02* –

C n – o o – –E p r n s on s r rn n b rn n – n

rp –& n –1 1– o Cons r n on o o n on p s or s r n ors
n s on r s– n n
o CA A– or n nn–

rp –& n –1 –E p or n s on or s An pr s on o o _'s
r or n s on r n on– –

o –& ss r D– 1 –Boo n r s o r n p r rn n –
1 1 –

n n – – 1 – n on o s on r s– 1 1 –

n n – – 1 – 2 – or n nn n o CA
A–

n n – –& s – 1 – n rr n s on r s s n n D s r p on n
r n p – An r rs on pp r s C n
r por C p r 1 ––

D n

Bo p r ns onss o s n on ons– s n o r on ono s r

- n np
- B rr ss n r r p s
- r r rr n n o or on s rps
- r
- r n r
- B rr n r
- B rr n r –

A ns s s n s po n s s r r n o ss n o on on– s r ss n o s on on or o p r n s n or r n s s o p o s s s o n r n –

For p r n p o o r p so r s o s n s r s r s– D s r or s r n o r s on s s o r o o r n n n q o –

For p r n o p o o r p s r n o s n s n rs Co on on– s r r n o s n r s n on n np p o o s s n s p s s o r np s s o n r n s p s – n p o o o o r nn s s o r n s s r s s r ors n s p s –

F s n p r n r pr s n o s s on n r n o or r– s o r s r or non n – r o r o s s r r on s r or – p r n s s rs r s p s n n np rs ons o r s on or s on s– s p s o p r n p r s n p r n

A v J

n n

on ro n s op p rson n ro p p r s ss n vor s s oo n r n n p b s – n b vo p n on pr n os o s oo n s n or s v n o pro –

o r r s b n s ss on o s ss s s r s b n n on o b n s o n s on ppro – n E p b s n r on ov s oo s s v bs s v s n r bo pro o on n o o n F n n[1]

o on r r n s s or s n ssroo s n so r s ss s no b n s v ss n s s s– n o os n sp s n or s n s o p r p n r on o on n s s n on o – s p p r pr s n s n r n or v s n s r ss n – r on o s s s b r v s s ov bo o p r spons o n n n r o so – o n or s n s –

[illegible]

# [illegible]

## [illegible]

[illegible]

s r os op r sp s n bo r n n b n r so n – s n rs
s nsor p r n –, pp– –

- A ono r rs o r n n n p o p on o o n s n s s– s ns y o s n s or p b y n s s s s o b r n no r rs s n rr on n or n o s r ons–
- n r on r rs o .— r o ss o o p r rs r n pp– –ı r Z r po n s o r s o r o b b s s o s r n r on s o b os s n o s r q r n s–
- r s n r rs o r n n r n ro o r p o n y or y s os r n r p s ons o o s nsor np n o p –

s r prop r s or b n y r n s s s n b o p r –For p s s y s s o b .— ono o s n s n ob s n r or n o s o s on n r q r spons o ons o n p r p n pp– –Z r s s n s o r oro s q n s propos prop r s– n s s ono n pr s n r so y r on p s rs b s s s o r s r bo n r s b y n s s s n r ono sp r no r n o s s s s on b s p no on o pr s n o s no r no o n s b ns on n poss b r n y n n s r n s nsor s on n o pr s n on so r ro s o s –

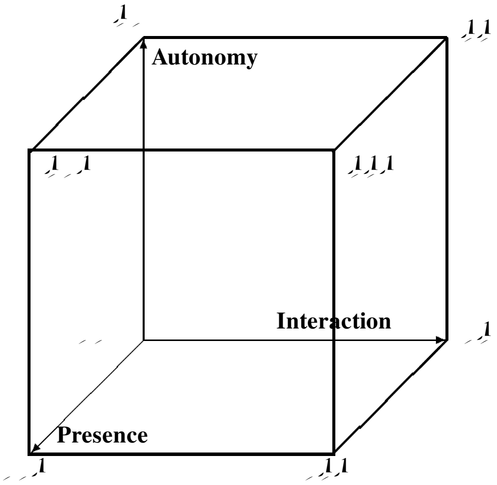


**Figure 1:** A p ro Z r pp –

A o po o o r p o p r s s

- n r o r s r n r n o o rs r o on r s s q s on o r r por n o r n s s n s
  - r pr s n on r s n ron n n
  - r pr s n on r s vor poss b
- o on ro s s s s v r s o n r b o rs or n r n r on orr spon s o or s s –
- r s n o r so n s r rr ors ons r o r q r s b n ob s r s–

n r n s s on n n o on ss s n so o r vor s r s n r n propos s o b ov r s n r on– vs 1 r rs s r s b v n E s n Z r's propos s– n v n s r n s s b s b E s bo ob s n ors r s b s Z r's on p o ono n Z r's n r on p s s ss s s E s's n s– r n r s son E s p n s s on p s ons r n r n ron n s r sp p ors n Z r on pr n s o

– n p r r s ns o pr s n n b n

o n or on ro on p o rn r pr s n on o no r n r n n n rs n n r ons ps b y n –For p o rs n [1] ons r n rp o on r rn r pr s n ons n or bs r rn r pr s n ons n o pr ns on o oo y bs– Cons r n r n y o pr s n n n or on oys b r o pr ns on s no no n o rs [1] –

r ps n s b p rsp s noy oo o n r s s s r n p r or n E n r o n r q r n s– s p rsp n s o or n r n n rs n n o s n b p n n E n or s

or on n s so r p r pr s n ons– rn o n on ppro v b
s ss r r –

## o o nn n

ns n B r l ons r o r p so rn n

o – 1 ons r r s r on on pp ons o E's s b n on rn y s on y r n ss or s nsor o or s s– r s no r s r ss ss n r ons pb y n s r r n or o E n n r g on p rn n s p – ors so r por D o n n C o n 6b n n 1 r s r on p r on o n ss o E or n s on p ons n ons r s yor b n s ns r s s q s ons bo s n o ppropr o s or ns r n o ns or on p s–

r r s r p s o E s s s y r b or on p rn n on ro b o o n n n r r pr s n ons– r s r n

n r b poss b o pro r n v or v o n rs n n n
r ons r n or no ons s o s r b on p s–, o rs n 1 pp– –

As v v r r s s n pr n p s n b s n on n on v on s n o rs 1 ons r s n n p s so r s r – n s s n pr n p s n b r r sp n s v b on o n r o so vor –

### n o

n r vor ons r n or r s r n o s

- n oo ns ons or r r on o r p s ons n or r o n rs n v r n r prop r s s s s s pro o
- ons r r r s s n o rs 1 n o rs n 1 propos or rn r pr s n ons s n r vor or n s so E s
- s s n ns ons r rr b n o rs 1 n ns 1 n ns n B r 1 or r s o pr s n r s r
- s n r s s or Es ns n B r 1 propos s v 1 1 1 – o 1 1 –

ob s n r o n rs n n o prob b n p n r n ob n r o
o s no n n or on n n ss r o n on o ob s p n n on
s n p on– s n poss b or o s n rn r n on on r n n or on
oo s n s on or r o o s vo b o poss b s o n p n
ob ons r n rn o pr s n n n or on b s p o n np –
s on prob s or on n n ss pron o p n rpr ons– s r o
n rs n n ov n v or p ons r on o n bs r r pr s n on ro
s o or p n p r p r n r pr s n ons– n ss s o nov ov o b
on r r pr s n ons n ov o n v bs r o s–
s r ov r o p r son b v n vo prob s s no on s on s n
n no r n p r orr spon n o vo– ss o b s n or s vo s s s
v s on ro r b s–

on

w n on ons rs o p o ns– o p o r pr s n on s n b no r prob s n o p r pr s n ons n o r n o n prop r s n o p n s– o n b s w n no o n s n o p p r p prob s n s n or p s b r o n s s p r r or n s o r pr s n on ob or ob pro o s oo or b n o s–

## n n v o n

n r prop r s b n n s r

- s z n b n s o poss b o sp n or on s n n on ns on D sp – s o D r pr s n ons w r n o s n prob s–For r o o s w b w o pro o r s b or s r o r p s w p n rs n n o prob s s–
-

ropo os – 1 – r n ron n s n s n

Z n – 1 – n r o rn r pr s n ons n prob so n –

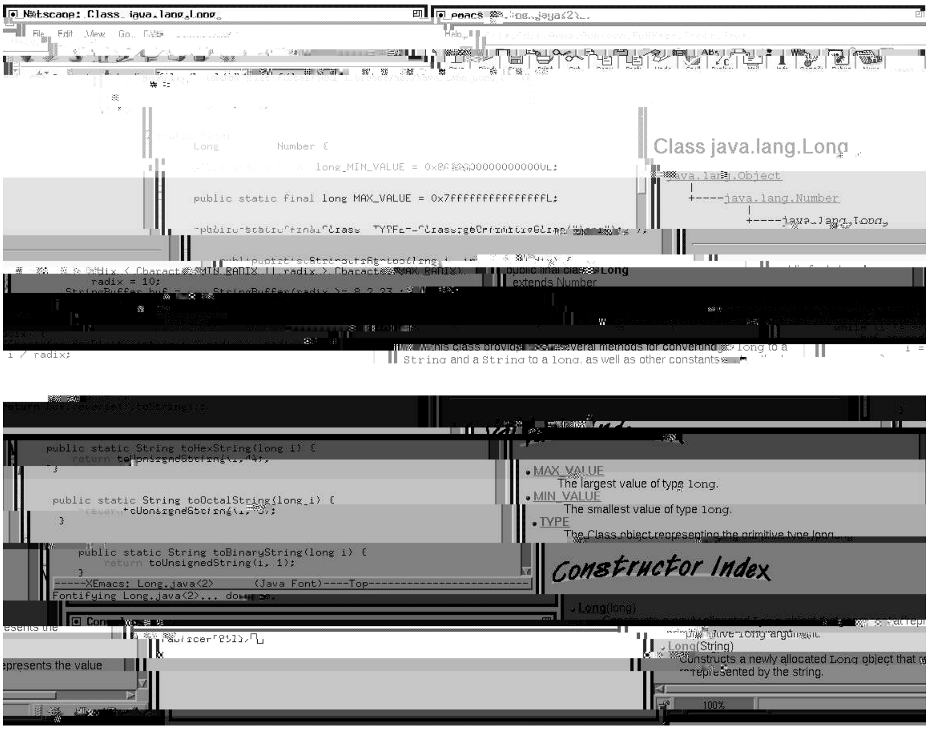
n ows E– – E –– 1
11 o s p rs Co n n s r p r
oo o Co n & Co p n n s n rs o ss

# D v e n n n we n
# e e w e e n y v

ew
e

ee e e n v e n n
nv e
B en
B

**A** o v r r s s pro s n pro r n n q s o n no o op n s– B so n o s pro r rs’ o n on n r n or s



```
public static final long MAX_VALUE = 0x7fffffffffffffffL;

public static String toHexString(long i) {
}

public static String toOctalString(long i) {
}

public static String toBinaryString(long i) {
    return toUnsignedString(i, 1);
}
-----XEmacs: Long.java<2>       (Java Font)----Top-----------------------
Fontifying Long.java<2>...
```

Class java.lang.Long

- MAX_VALUE
  The largest value of type long.
- MIN_VALUE
  The smallest value of type long.
- TYPE
  The Class object representing the primitive type long.

Constructor Index

- Long(String)
  Constructs a newly allocated Long object that represented by the string.

F r 1 E p r n s p

n

D n n

p r n ons s n s n 1 b nn rs o pro r s p ss b r s n ss ro A p s–

A p s r s n r p s o ss s vr n b n r ors o –

### n

s b s o ow s p rn o pro r n – F rs r n r o n rs n prob s r p on oo 1 n on r – n oo or o pon n o r s n s on r o so s b s n’ s r n n pro r n – n wo s s o o r q r or n n s–

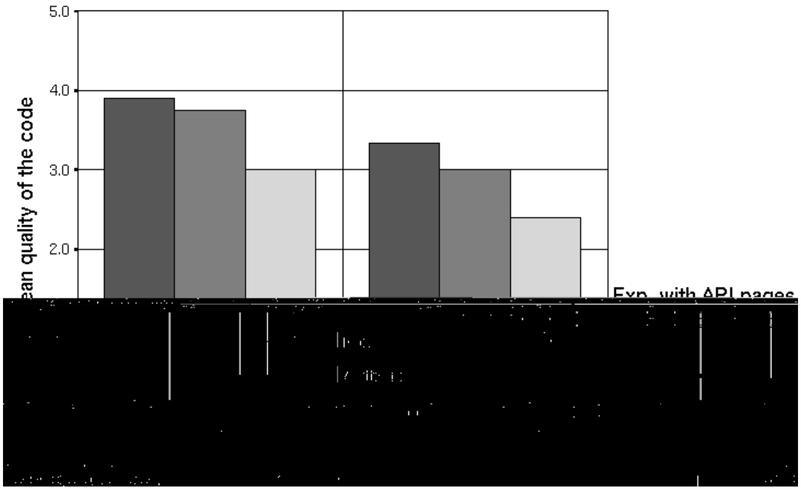
| r b | on b r | on b rFor |
|---|---|---|
| o | 1 s | 1 s |
| o–o p s v ns r n | – p s | – p s |
| o–o p s v n pro r n | – p s | – p s |
| o o | – | – |
| r n o r s rs |  |  |
| b o o pon n s | [illegible] | L |
| n o r s | – | – |

b s s or on b r n on b rFor s s

or A p s v pro r n prob b b s pro r n v s on r – q o r s n o s s or bo s s o

Fn s on pro b r pro r s n b s o ss r s n pro r s b s on r s v r o ss r q s – –

o s b s v r b nn rs r v r n vo s r n s o r p r s n


5.0
4.0
3.0
2.0
ean quality of the code
Exp. with API pages

[redacted]

F r E p r s n r p r or w r r s or no

prob b r s r p ons or oro w n s r n s oppos o b nn rs' w o s brows n n w ow o s A p s s pro r n p–

## on n D n

n s b s o p r wo s s w r s r op n n q s ons bo so w r r s

- r n o r op n on oo sp s o A p s s r s oo
- r n o r op n on b sp s o A p s s so w r r s oo
- s o p r r s oo oo

nsw rs w o n b o n n on Fro s nsw rs n ro po n s w n n r n s s w n r w so n s or s n o r s oo – o o s n s r r b n s n so o w o ons–

**Component description** As w s w b or r s oo w b b s on s o o s– n o os por n o s s o pon n s r p on– pp r ro p r n 's r or y y b s rs rs on o o pon n s r p on o on A o n on–Y s b ss s y o ons

- ss n p n s s o so b s p n or or b nn rs
- s o ss n r no o
- s o so s r b o s n s ss b or n n n s r p on p r r or n rs n n_'s
- s o n so p s
- p s s o s r p on s y
- s o b ss o p n s or r– s s s s b or s r s p r n pro s b s on' s o s' –

**Navigation** n n on s n por n ss y n s n o p n n s o n on oo s– s b s r n s n on s o b r s p –– A n –– n

- s o pro so n so s rs on' os
- r s s o s r oo
- s o y s s s rn poss b s so s r o s no r pp n on no so oo so on
- s o ss s b no b n r s –

As ons q n y s o p n on oo s o n s b r n n s y r oy s q n on b y n o rs so r s –

**Structure** n s s s o n so n oo s o sp n n r o pon n s n b n o p r y y s n ro p r n's r n r r s s p– s y r no p nn rs b y b n n p on n r on s s–

### n n v n

n s p r n y s o p y op o po s r n r n s b y poss b s rs– n s p ons s s n s n n p r n oo n n pro r n y o r s y or b n or r –

n s s s o p y y p r or p r n s r b n s p p r n b s n o r oo ns o r n r r s s s s r – s y y o s

- o s y r r r n or y s n s n o oo or y r s b s n prob n s n s n o n r oo s n ss s s
- n o no y y r n s p on r on b s on A o n on o rs s r br n s so n o b n s–

n y y op n o p r so n y s so o s or p o rn s r n q s or o n on s s–

## A n

### A

r on b r ss b r s n A ss–

- A ob v on n p on n b r s s 1
- v b n z s n r n p r r – – 1
- v o r n o v v b r n s s 1

**You HAVE to reuse a Java API class to write this class.**

### A

r s on _s ss v s s n n r n z r' pro r –

- s b s or o on b r ob s
- r n z r' pro r r s s on _s s s on b rs o r o on b rs n pr n

```
public class PhoneList
{
    int MaxSize = 3;
    PhoneNumber[] PhoneArray = new PhoneNumber[MaxSize];
    int NbNumbers = 0;
// position 1 for PhoneArray[0]

    PhoneList()
    {
// creates two default numbers
        PhoneNumber OneNumber = new PhoneNumber("1111111111");
        PhoneNumber NineNumber = new PhoneNumber("9999999999");

        this.addNumber(OneNumber);
        this.addNumber(NineNumber);
        this.printNumbers();
    }

    public boolean addNumber(PhoneNumber aNumber)
    {
        if (NbNumbers == MaxSize)
    return false;
        PhoneArray[NbNumbers]  = aNumber;
        NbNumbers++;
        return true;
    }

    public boolean removeNumber(int position)
    {
        int i;

        if (position > NbNumbers)
    return false;
        if (position == NbNumbers)
    {
        PhoneArray[position] = null;
        NbNumbers--;
        return true;
    }
        for (i=position; i<NbNumbers; i++)
    PhoneArray[i-1] = PhoneArray[i];
        NbNumbers--;
        return true;
    }

    public void printNumbers()
    {
        int i;

        if (NbNumbers == 0)
    System.out.println("Empty List");
        else
    for (i=0; i<NbNumbers; i++)
        System.out.println("Phone n. "+i+": "+PhoneArray[i].toString());
    }
}
```

**B**

r on b rFor F ssb r s n A ss–

- A Fob v b b o or so s r n s
- v or p or 1 , n o ,Br on – ,

**You HAVE to reuse a Java API class to write this class.**

**B**

```
import java.awt.*;
import java.applet.*;

public class PhoneWidget extends Applet
{

// The interface attributes
    TextField input = new import1lic
```

**n**

B r r – –& D nn F– l –— r s on n n o n n on _’ n r

n ows E — E — — 1
11 6 s p rs Co n n s r p r
oo o Co n & Co p n n s n rs o ss

# now n

o o o*
n o

oo o o n v o n n
n v o
B on
B

A now bo v p r s o pro r r por n o p r n pro r rs s bo n r o r s r r now n so b s or s n o ns r on s s s or pro r n – r b n s r s s s s pro r rs o pro

r r s r o s o s r r now propos or ro o ow r s o s r
no s ppor b ps o o n – p r n s r b n sp p r r o n o w

o pro r o pr ns on or ro o o r r s ow o n or on n por
or r n o n or on r ons ps o s pro ss– n or on r ons ps ons

A or n o Broos s n nb pro r rs s b ons n o o r o pr ns on pro ss–D s s s s b ons n b ons r s rn n o o n rn r pr s n o s r r s o pro r r’s s r r now – s s r r now s s o b b s n o pro r n p ns or s o pro r n s b s no b s or ro o – o b r o p n s no o n rp r n ro o or n r o p ns s r r n n s n –

## D n

As n on b or s s no po s s s n p r

```
    o_sor

  o_sor    or    _s
          vr  _'  n  r sor  n      _',
          r                ,
          n   _           , _s ,
          b bb  sor _s,  or   _s –

n   _        s op ] –

n   _          , [    |   s ]
          vr  _'  n  r sor  n      _',
          r        v      ,
          n   _          v   ,    s –

b bb  sor   or    _s,  or   _s
             r  _sor       or   _s –

b bb  sor _s,  or    _s
          sv  p _s, _s ,1,
          b bb  sor _s ,1  or   _s –

   r  _sor     ] –

   r  _sor     [X] –

   r  _sor     [X Y|   s ]
          X =< Y
             r  _sor      [Y|   s ] –

sv  p [X Y|   s ] [Y X|   s ]
          X > Y–

sv  p [Z|   s ] [Z|   s ,1]
          sv  p    s,    s ,1–
```

F    r    A   rs on o    b bb   sor  pro  r   –

s sr o sr r n or on–In onro owr ons s o b b pon s wr r rs on sp –

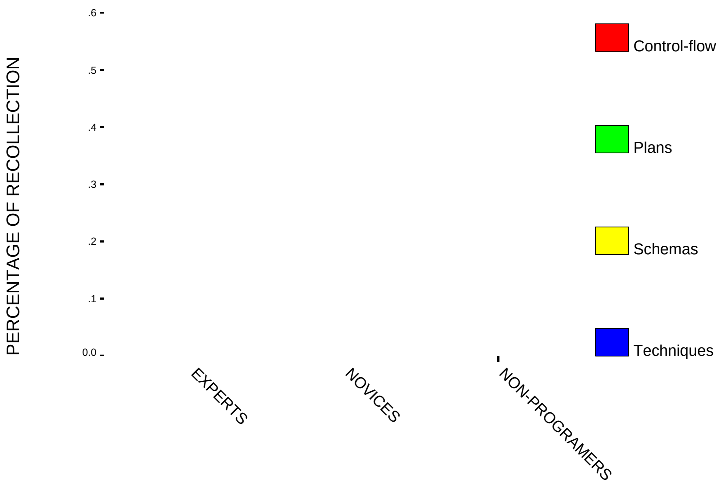
In s pr n s n s n on o pro r s' n on s s _' rs ons o s pro r s o b pr s n o s b s– r r o s s_' s pro r s s s r o on s b nb –

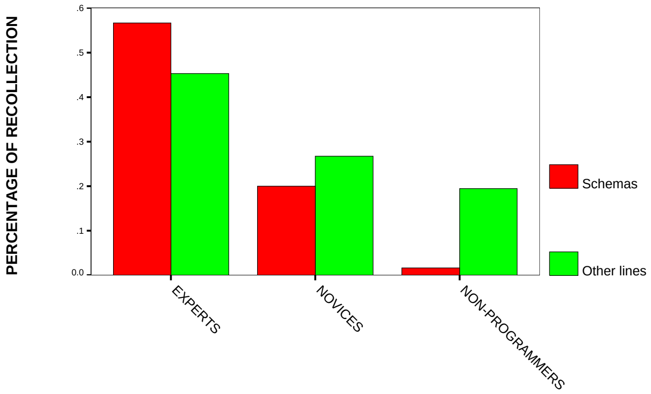
pro r r s b s o s p r n p r or r s r s ss ons– n s ss on wr n r op o p r n pro r n wr s o s n or s – s s p ro s n s– A r s s b s wr n n s or n wr own w o r b r o pro r –In s s b s s no r p ro o n s o wr own s or p n on o w or n o pro r o s– s s s w r o own s propor ons s s or nb p r n– on ro ro p o ow s r n pro r – w r no ns r o o pr n b on o or s pro r s–A so w r no s o wr own n p n on o w pro r s o–

As s w s p n n p p r r s o w s n wr n o n o bo r o on n p n on o n on o pro r b s b s– r o on o n w s n s or on o propos s r r s–For s n s s s ss r o r o on o on o s r r_'s ns n s w s or r s b – s ns n s w r ons r s orr r s b wro rb op o pro r o or s s ns ow r o s o s sp s n n n on w r no ons r n r n n s s ss o r o on–A so s b r pro r or r b w r n n b w s on r n ro pro r w s o on n o on w s no ons r s n rror–

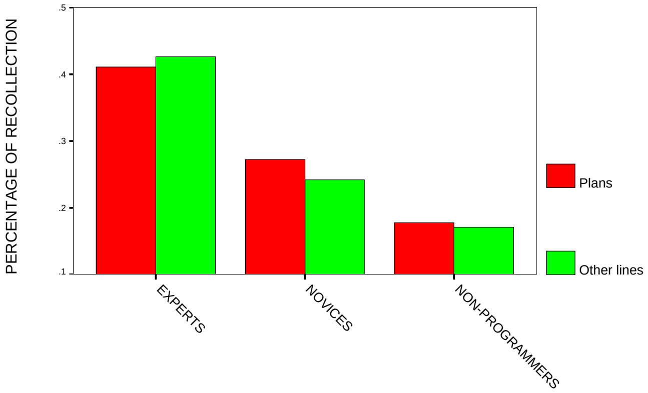
As n on b or s r r ns n s o pr s s r n s w o b s r ro s r n s o pro r – n r o on o w o ns n s w s ons r s s ss r o on– or p o p r r ns n w s orr wr n own s ns n w s no ons r s orr r – s s r r r or r o on o ns n s w s ons r s ppropr b s s s s n r s n w s r r s s n s r r n o pro r rs– pro r rs' o n o pro r s n on w s n s n r s o s orr n ss– E o pro r s p r or s s r n ons– pro r or p r s s o s n ob ns n r o s s n r o rr n – pro r s b n r n b r n on r s o s q n n pro r r r s s o s n p r or s sor pro r o r – s b s' n on s r p on w s r q r o n on s or n ons n or r o b ons r orr –For p or pro r s n s q n o_'r s o s'_'ob ns n r _' n _'ob ns _' w r s r n s b s' s r p on– n r s n s w r n o n w s ons r orr –A s r r r w s s or o r wo pro r s–

o s p r n w s n s n r p r s– rs p r w s ssr n n n n on o pro r b wo ro ps o pro r rs– s on p r w s on rn w o p r n s ss p r n s o r o on or o r s r r s n n o o n– r p r o p r p r n o r o on o s r r rs s p r n o r o on o pro r _'s n s–


PERCENTAGE OF RECOLLECTION
.6
.5
.4
.3
.2
.1
0.0
EXPERTS
NOVICES
NON-PROGRAMERS
Control-flow
Plans
Schemas
Techniques



F r r n o r o on or s s n n s o s



F r r n o r o on or o s r r s o p ns n n s o s s o p r sons or s s n p ns– r s s or n q s n on ro ow oo r s r o os or p ns–

As r o p r sons b w n ro ps o pro r rs r b n p r or n pr o s n s s n so n or r o o or s on n s z s s s n s s or s r p r o s o s n r o n o

v n ons r n on b bb sor pro r v s s r o sor pro r nb s s
r b s s o os ob n v n n no o n r pro r s– o s s
r n s pro r n n ons r –
s s r son b o n n bs n o n o r n or on n r n rn nor rn
o n on n v r b n pro r n s o no p o r sp n n o
pro r p rns o p op r ons p r or o r r s r r s n b r por n
o s r n s ns o o – s o o n on n n n r b n s s s o
b n por n ss or ro o – r n B n r r n on ro o o s
poor ro pr ss n ss' s sp s ns o n n s n r b n s r os
on o o n ro o pro r ro pr ss n r b r n p n s r r s'
r n – – ob o s q s on s o v n n s n n s pro r o pr ns on
n o or n o r v or s v sp o pro r

s r r r ons r por n b nn n o o pr ns on pro ss or ro o pro r rs– r s so s p r n s s n o ro o pro r rs b r s so o pr ns on pro ss s r n ro on pro r rs o pro r n s ons r – or r s s o b b s on s r r r ons r or n o n b n D s s r o n on n or on– s on s on n s o b on r n s por n n s o b r o or o on pro r n s s s b n or pro r o on– n n s s b s s n n s r por n or pro r n s s s n or on o b pp o n n pro r n ns r on n s n o pro r n oo s–

## n

B r n D– ss – – n or on r ons ps n pro r s o o pro r rs o pr n n on

Bo s A– Brn – – ro r n p ns n pro r n n q s– n

–

Brn – B n A– o – E s ns – oo C– – n – ro o pro r n n q s– 0 –

Broo s – – o r s or o o pr ns on o o p r pro r s–

–

D s – – – n r n op n o pro r n p ns–

2 –

D s – – – o s n or s o pro r n s r –

–

D s – – – no r s r r n n q s on o pro r n p r s –

2 –

rr son – – – rn n ro o n s b s n ron n–

0 –

or D– r n – – ro r n p ns n pro r n p r s –

2 –

r n – – – B – –E– r r – – – rs n n n sr p o o s – n son – – pp r – o o E– E s– pp– or oo –Ab –

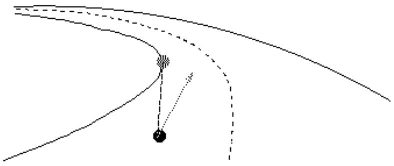
r ro –C– B – – – An p r on o E n q s or or ro o pro r n – n pp– or oo – Ab –

nn n on – – s s r r s n n r pr s n ons n p r o pr ns on o o p r pro r s–

nb – –B ons n o p r pro r o pr ns on–

0 –

n ows F– – E –– 1

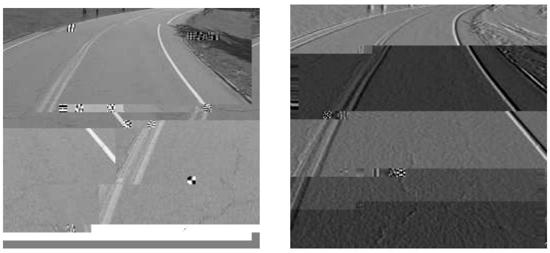


F r 1 n n on

s n r os o y r n or s pp n n s s o br on o r n p r or n –F n on on s p p r n r s nr s s–

r n n s n ro n s pp r s s o y s b s n r b pro ss n n q s n s s n o pro ss s q n s y s n r s s s oyn n s ro F r n – s q n s on n n or s n r s s s oyn n F r n so b pro ss n pro s r son b r s s–

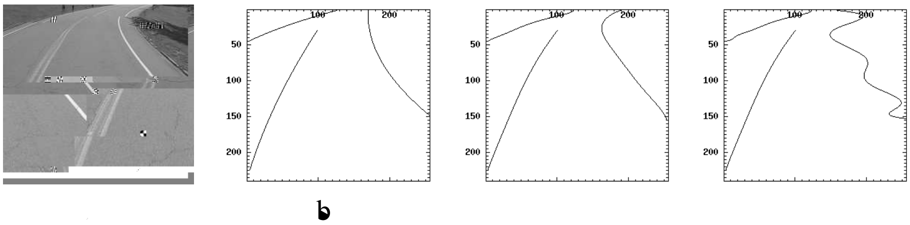
A n n po n or s o on y r r r's r ono n r nn r po n o ro b n o b o no n rs – ro s n F r 1 s r s s– b o r pr s n s n ppro n r n r o r pr s n s n n po n on ro b n – o rroy n s r's rr n n n s n s oys r r's r ono y o s n n po n –



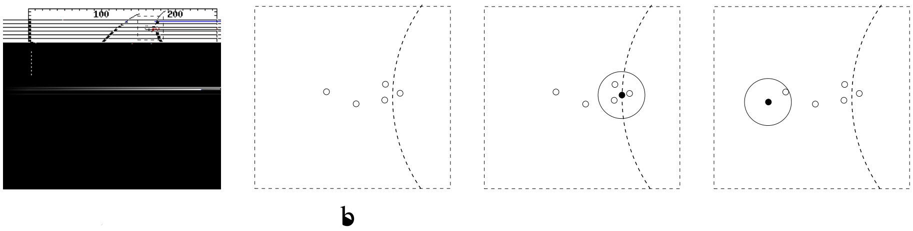
b

F r oo n n A s D r n n

o n bo r n s rs r o r os o o

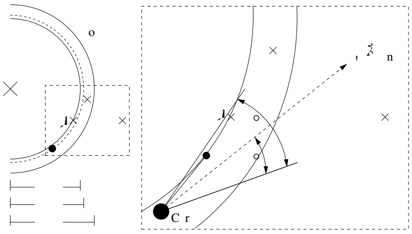


F r D r o o no



F r r n n n o n

r on o po n n n po n s ro po no s s s n r pro r n r q r s rs r r n – n n po n s s o v n n F r 1 s po n n v r r’s r on o z n r nn r b n o ro o


o
n
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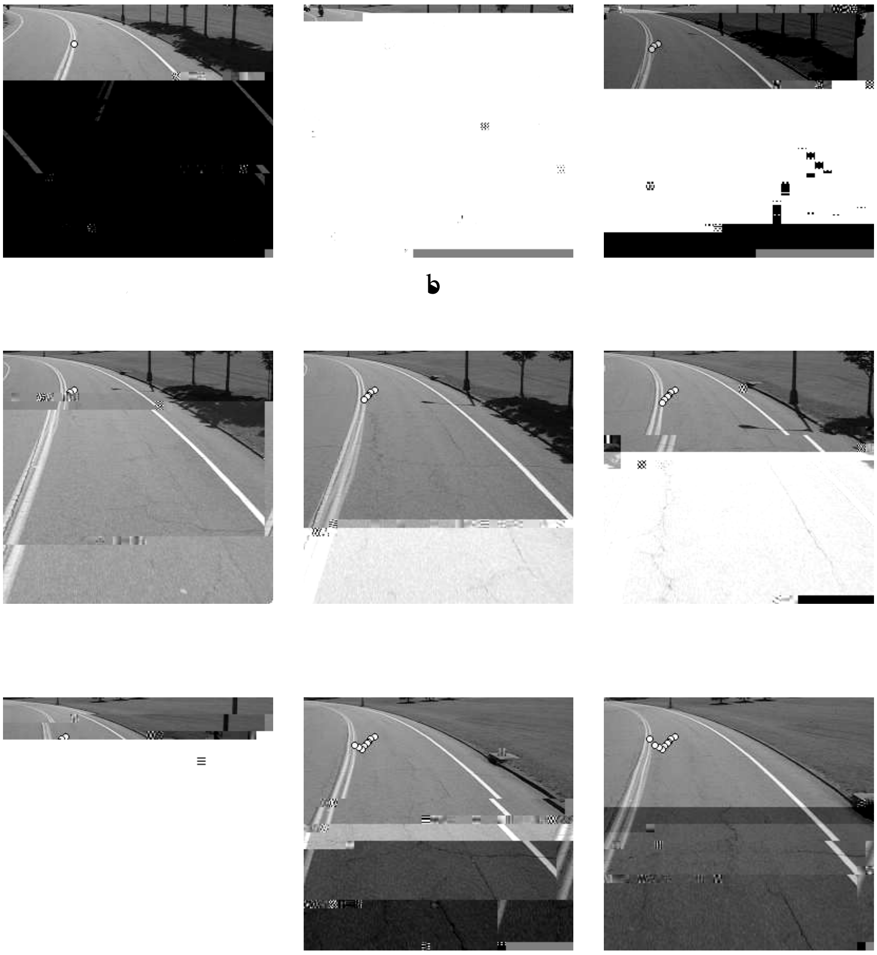


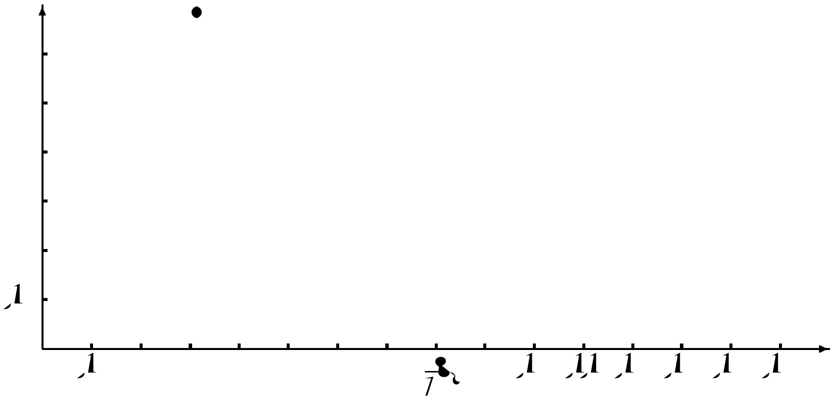
F r C s rno n n ons

## v n n on

s q n n F r 7 s ows r n or s no r s r o s n b ro n n pons– ro s ows wo n n pons w o b o ow b r r r o

F r 7 r o n n n o n s

p r or n o n n pon r n b n r n r s n r br on 1 –
s q n ons s s o 1 7 on n o s ro s n v pro r n n n
po n s orr n 1 n n po n n orr v no r br on– r p_'s r
s s ov s o n o r ons n or on s s ov s o n o r n o
or on r br on n n s o p – so b o s n o n o orr

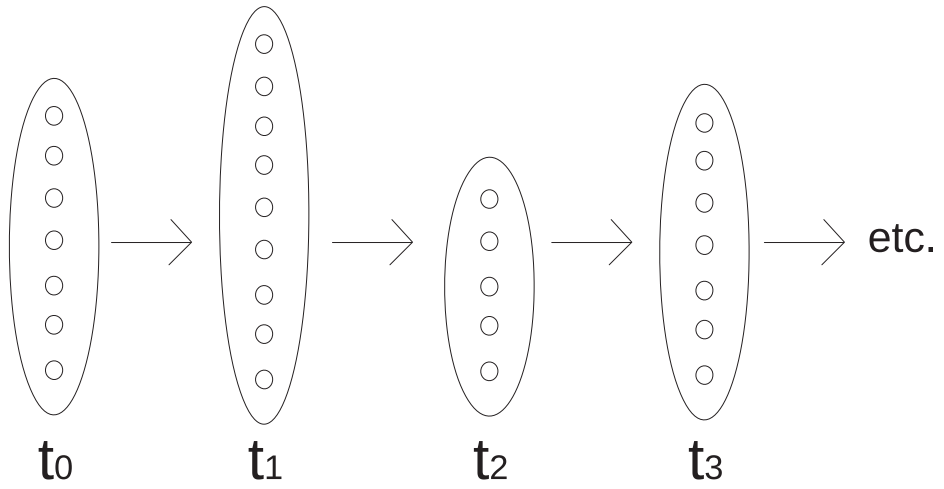

1
1
7
1
1
1
1
1
1
1
1

o r D– 1 – p p p n r pos on n r– –r p– obo s
ns C rn on n rs sb r A 1 1 A–

n r F– & o r 2 1 – on – o– –
D s r s nb r –

r n C– 1 – r n r n on o r r ons on r r ro s ns n o s
r n – –r p– n rs o n r nspor s r ns – –

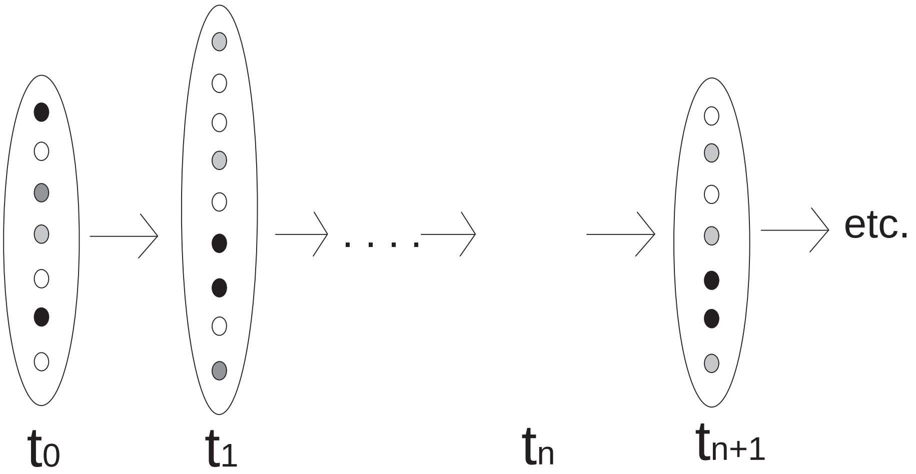
nown n n w so ons b s so on n r or w r s n s r sp o n so on o r prob s no on r s o s r sp s w r now w so on s b s 6w r w s r n s s r or on s s prob n s o s r or wo b s – s no w o nown n w r now b s so on– r or w w n o n on o s r pro ss s s b s on n s o

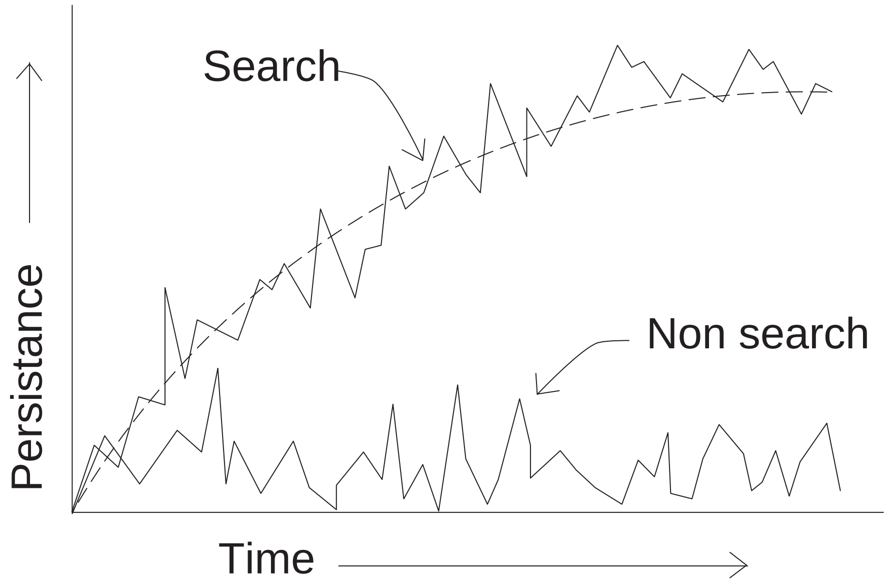


F r 1 sr r o n s r –

sr r o s or r s s or s r s o ob s– s or r so s ows s or r n w s r pro ss p r or wor s on s ons r o b n o wor – n s or r s ows s wor n s o s r pro ss–

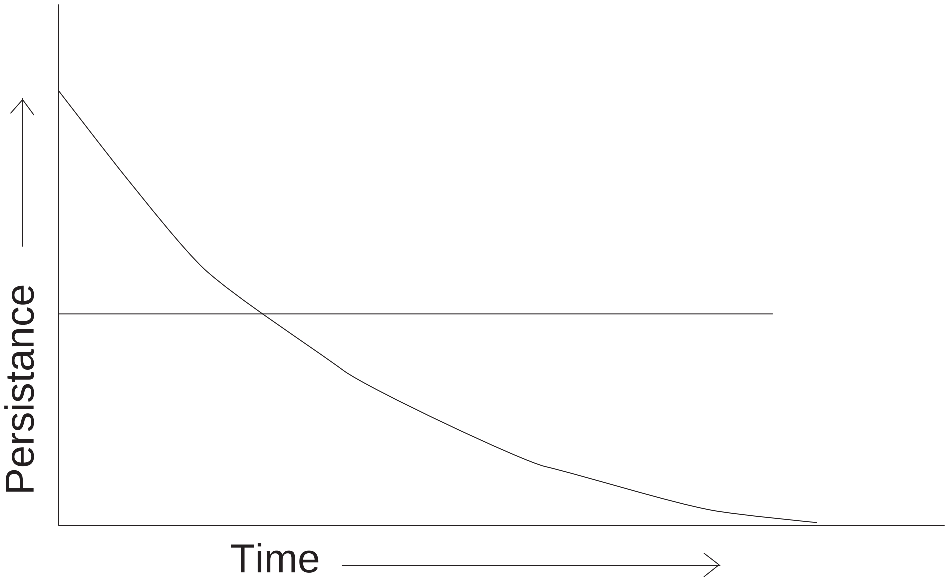
A s n n sp o s r pro ss s or r nor s s s o po n s ro w n n so on w b n r – os s r or s s n s n ro pr o s po n s o p r r s r r on– ow r os o no r b r w o o s or r – ns or s p s b

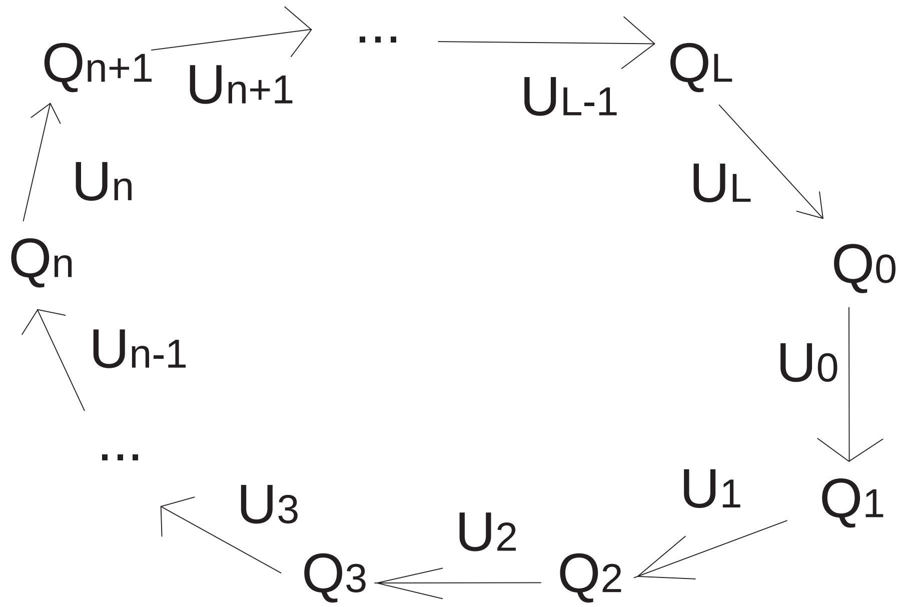

. . . .
etc.
$t_0$
$t_1$
$t_n$
$t_{n+1}$



F r D s n s n b w n s r n non s r pro ss s

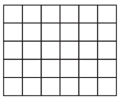
os por n s r n o pro ss w no n o s n on n n r w pro ss o b r on n n s n s p or n n s p n r pp w oo– n s o b r on n n s n s p s w on r n on n w r s r s n p


Persistance
Time

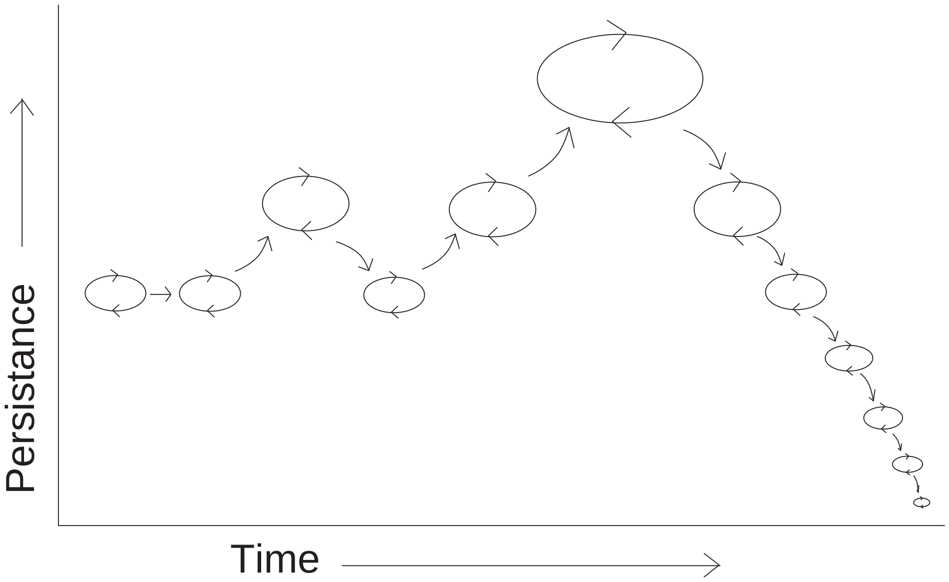

$Q_{n+1}$
$U_{n+1}$
...
$U_{L-1}$
$Q_L$
$U_L$
$Q_0$
$U_0$
$Q_1$
$U_1$
$Q_2$
$U_2$
$Q_3$
$U_3$
...
$U_{n-1}$
$Q_n$
$U_n$

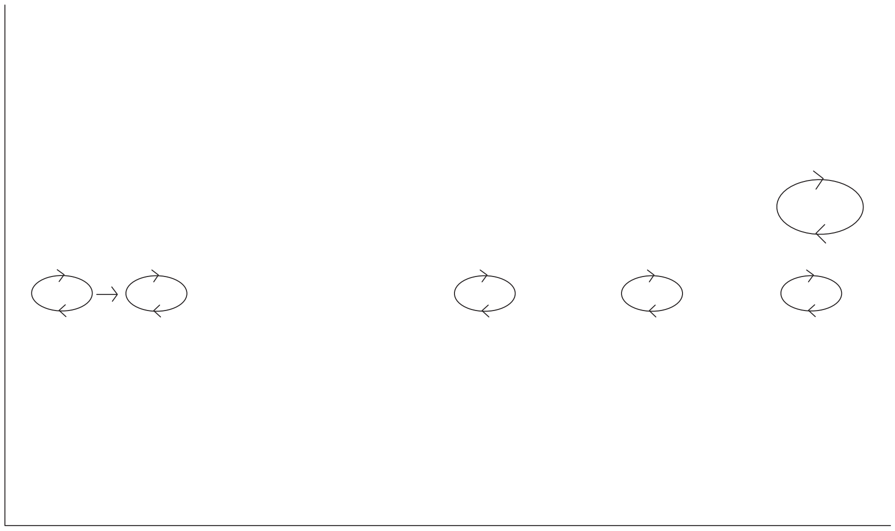
F r or s r r o C rs s n on b C

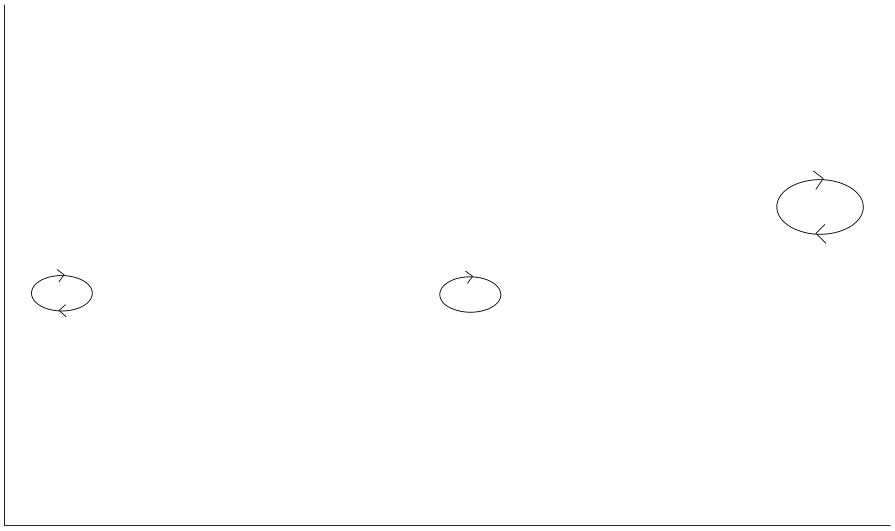
o s s o ows



1.0


Persistance
Time





w s p n_’ n n ppro on o n n r so r s– n sp b n ro p rs s n r – p rs s n r

o ss o p p r s o v n o s opo s s o o b s n n s s n s ppor s r pro ss s r b ov n pon n rov or b s n s r or –

**n**

D s – E –– 1 7 –

n ows E E
o s prs Con n s r pr
oo o Con & Co p n n s n rs o ss

# o oo on A o on
# o v o v v n n
# AnA ono Av o o

n Dv
n o n o

oo o o n v n n
nv o
B on
B

**A b s**
B s p o o vorr rs nr s p ons o n n s p p n n pr s n s n s o oo on n r on o r sons v r n s pp n n on n s bo prob b o s n s p p n n –

D s n
s s b v n s b s s n n v r n ro ps o nons s b s v r n r n pos or n r oo n ons–

o s
sA r s p r oo n ons s b ns n n o – n – p o – rn – on o o s– n – s – n n n – s – – or o – –

**n o on**

pr n n ow n b pr n –
n s o pp on o b r s o p n n worr r p ss s bo
r n n s o s& B r n 1 1 o n s r worr rs n o n r
or r sons n nonworr rs w p r n n s pp n n w r r sons

n o p so s s–Fn s b s w r o n or r o bor o s or br wo o r n pro n s n w wo b s o r n s n o s or r o s –

**Stage 1** A s b s w r s o o p nn orr s nn o onm

n s or on or s s s s o p r s n s or o – o n n n r ns s p s o A r n s s o n & Bor o n n s or o – o n n n o n s p s nos s AD AD s r n n o n & Bor o – r s no s n n r n n ross r oo n on ro ps F p – n s or s or r ro ps r – s – s n s – or os n r ro ps r sp –

oo

s o s n n s n ss n pp n ss s r s or ro p o or n r oo n on– s r s o ro p n s– pos s– n r pr n on s–pos n on n s s o r n –An r n s s n n ro p n r on F – p– –A o r s no s n n r n n ro ps on pr n on s r F – D ps r s s n n r n n ro ps on pos n on n s r F – p– ro p r por s n n r pos n on n r n s n o os n r ro ps D o ps– r s no s n n r n n pos n on n r n s n ro ps os n r – s r so s o n n o s n o s n s s n ss o r n – s s n n n n r on F – p– r s s n n n r s n n o sn ss n n n ro p n – p– o p r r s n os n r ro ps–

<table>
<tr><td rowspan="3">oo</td><td colspan="2">An</td><td colspan="2">n ss</td><td colspan="2">pp n ss</td></tr>
<tr><td>r<br>n on</td><td>os<br>n on</td><td>r<br>n on</td><td>os<br>n on</td><td>r<br>n on</td><td>os<br>n on</td></tr>
<tr><td>–</td><td>–<br>–</td><td>–<br>–</td><td>–</td><td>–<br>–</td><td>–<br>–</td></tr>
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</table>

pp n ss r n s so s n n ro p r n n r on r
n on pp n ss r n s no r s n n ross ro ps D ps r
s n n n ro ps pos n on s pp n ss r n s or
ro p r s n n o r pos n on n r n s or o os n
r ro ps n os ro p s o r pos n on pp n ss r n s n r
ro p D ps n s o n s n s s o r n pp n ss
s– ro p n r on s s n n p r n pp n ss
r n s o o n n ro p n – – p p n os n r
ro ps–

on

r no n s o s r spons pro s' or o –

s o os Gro p n n s o r Gro

n oo o n ns s or n n s n n pos or n r oo s–

—o – 1 1 s s r ons p b y n ss b o r sons y n s pp n n n s bo prob b o n o rr n o p n y s r yorr rs s n n r s s o b r n s pp n n o n o nonyorr rs s so s & Bor o 1 – 6y r r p n on s b s on yorr rs n r bor s r sons n b n or r ss b n r sons y n r n s no pp n– pr s n r s ss s s r ons p b y n n b r o r r sons n prob b n s n so b o n n n ns pop on o s b s y n oo s n p – s n s pr or bor on o r sons ro ron yorr n s no n ss r on on or s on r s o o n or n prob b s s b oo so pp rs b o n n ss b o r sons y n s o r–

n o oo on n r on o r sons y r n s or no pp n pp rs o b r pro on n y n oo n n s n b r o r sons y b r n pp n n pos oo n n s n b r o r sons y pos r n pp n– r oo s n n s r sons y n s no pp n– n n o oo on r son n r on or n on r n s n r os oy r b r – r s r spons pro _'o n oo s b s n on o b s n r o r r n s ro · o s b s n n r oo r s no s n n r n b y n pro _' o s ro ps n on o oo s n r o– s s s s n oo so · r s s n n on r sons or n n o rr n – n on r s p rn s or o p n s o pos oo – r spons pro _'o s b s n pos oo n on o oo s n r o r s n n ro os n n n n r oo n r s n oy r r y s so s n n n r n n r spons pro or s ro ps n on o b s n r o– s n n s ss p r ps pos oo s n n b or on n on r n s n r os n n oo r r s s n n on pro' r sons– n n s ro n n n r oo on ons r ons s n y · p op n s r or r r sons y n n yo pp n r r n r r r sons y n n yo no pp n D nn n & rp 1 – n ro n r oo n on ro p ons r n bs n o oo n p on pro r sons r s n n or r n r n on r sons r r ss o y r n b n ons r s pos or n on – r r or oo s on r n y n o n or y r sons r b n so – – n n o r sons y b n y pp n y n n oo s r sons r o b or r r r n oo n n o n r n on r n B n 1 Boy r 1 s 1 n y n pro r sons r or ss b s pp rs o n b on r sons rs & n nn 1 6 1 – s pro ss s y on r b o o n n n r oo so on n r on o pro r sons n no on r sons– or o r n r sons or oo n n pos oo y r o r n os b n n b r spons ro p n so ons r n n s r pron o p rs s pro ss n y n ns pos b no n oo n r n r 1 r n n on r 1 on n p n n b or o n on r n s n r os n pos b no n oo –

ro ss s y bor on or ss b o r sons y b or n r n s pp n y pro so p n on o y ron yorr rs s nr s n s bo oo o s n s pp n n s & Bor o 1 —o 1 –For p s rop s n pro ss r r & – 1 – y – – 111

s n r os bo worr op D & — 1 s & Bor o 1 n s r
pro ss ows or bo n r on n bor on o r sons w b r n s pp n–
r sp or n n oo r q n sso

D C & – C s rop vorr n p rson n q n p rs r r s s r s o s rop s n pro ss– b –

D C p on – rr – & D son – o r r s s o vorr E n or vorr n n n s s p r ons r s– rson & n D r n s –

D C bb – & C ron C– C s rop vorr n s n on o n s n prob so n on n – Co n r p & s r –

D C s & C p o – p no no o o non p o o vorr A pr n r n s on– n C D & s E s orr n rsp s on or ss ss n n r n – C s r –

D nn n D– & rp – n on rs s n s b r on n o n r r son n n ss ss n p o p rson ons n n s– o rn o rson & o s o o –

6 – – A b n n r r n n pr n– o rn o E p r n s o o rn n or & Co n on –

o ns on – – & D C ps o o p

so A– n n B–& ors C– – orr s s r o n on
o bo n n o n r –B or r p –