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

Editor:
Fabrice P. Retkowsky

CSRP

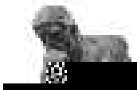
October 1

ISSN 1 0- 1 2

UNIVERSITY OF

Cognitive Science Research Papers

T A



n o n v n g n n

A s o orns s s no r ro w r s s n w w b n s–

on n

n B n n

s nob n n s on' ob n

rn n bo s p n rb on ---------------------------- 1

n w

Con r on n r pro ss n

voro s o r o n ono s ---------------------------- 1

Ann

ro n En op o n p

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

ne

D p r rn n En ron n ----------------------------

ew

D op n n p r n vor b n

o s so v r r s ro o n p rsp ----------------------------

r r nov n ro o ----------------------------

n en n

n n on 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 ----------------------------

[illegible]

[illegible]

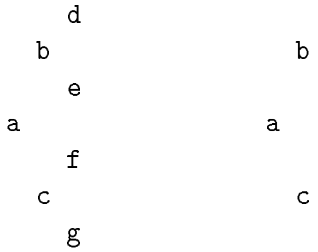
[illegible]

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 v or n r pr s n on o prob n p r on v b s n rn r n r s v or 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 ov n vo 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

$$(\ ) = *$$

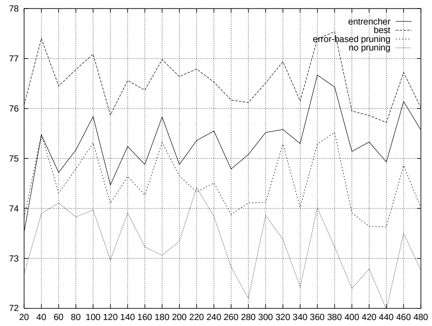
v r s n b ro s o rs n s o so r – b n s n s r b o ov n s or poss b s or ( )

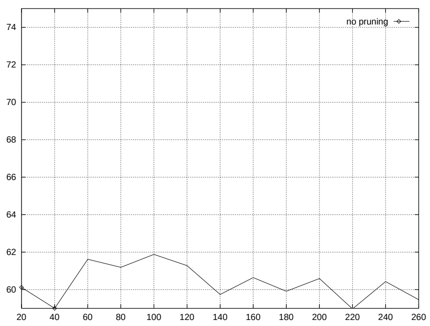
$$\sum_{=} (\ ) \, o_{(()()()())}$$

prob s r por n r n – 1 1–G 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 v r os n n 1 prob s o pos b r n n n s s s v r ons r or ss on– rn n s s v 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–

[illegible]

r 3or s pop r n v spr b s v n r poss b pr r s p s po s s– n n on s bo s n s s n n vo pp o s p o b v n r n rn s– n n ro n s o r 3or on so sor


entrencher
best
error-based pruning
no pruning
78
77
76
75
74
73
72
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 s 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 noy 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 ı ÊE E Gı Ê v n o oos b v n ons r ors n s p b s n rn r v no r b – no n v 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 –

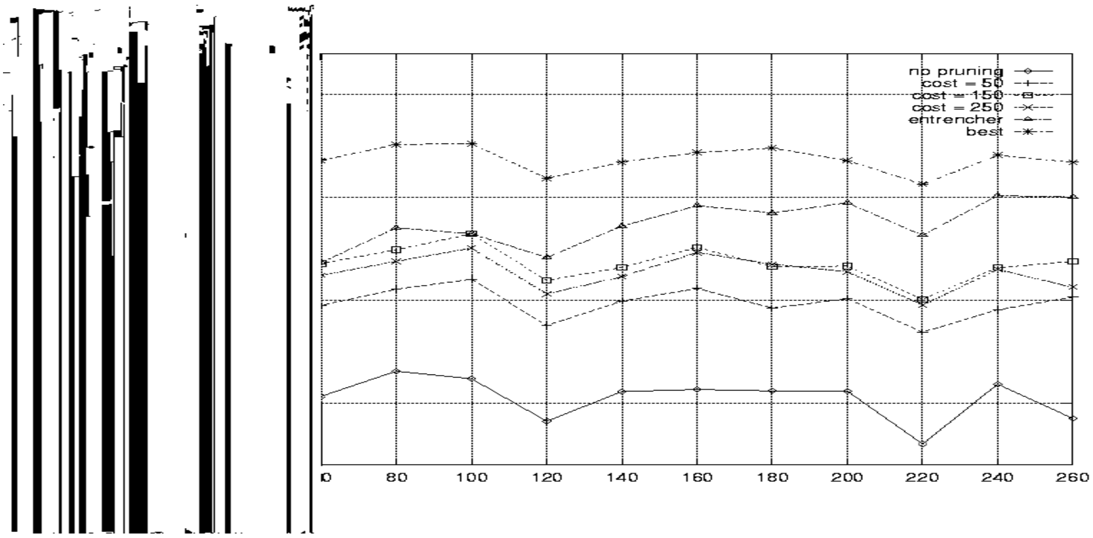
ov s r r o prob s n no o no p r s o n ons r or v n r n v r b s b b ons r or pro o rn n s r o s – o rs prob n n o o n o p r s o or n on ons r or–

nn

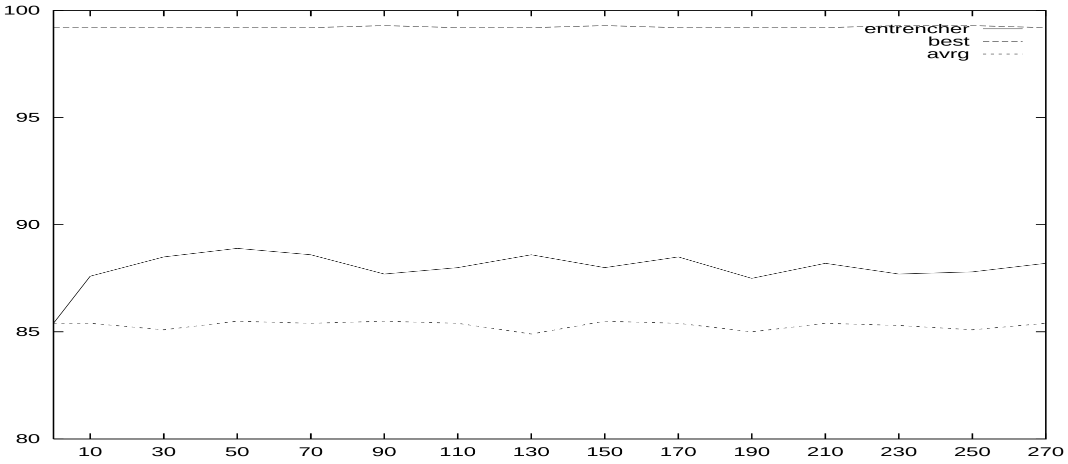
For s p r n s 1 ACE ss ons s n o n r prob s vo n o o n o p r s o ons r or v r n r – For ss on 1 prob s v 1 r n n ns n s v r n r – r or n o ons r ors v r s r n s s o pos o v o ss ns n sp ns n s – rn n s s v s r n on n n r s n n b r o prob s n n s on non o r pp n s s s o prob s– p r or n s v s n o p r 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 1 r ns n r r n n s s –

ov s n r r o r ps b v n o ns o p r s r n o p r or n b v n b s n s on b s ons r or b so s s no r s n s s or ı ÊE E Gı Ê

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 –



F r rn n ow os o p pr n n s r q r


100
95
90
85
80
10
30
50
70
90
110
130
150
170
190
210
230
250
270
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 –& ɜɜ 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 –& ɜɜ n – 1 –E p or n s on or s An pr s on o o _'s r ɜor 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 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 b 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 ns n rs Co on on– s r r n o s n r s n on n np 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–

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

n ows E E
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

o n n o o n

n n oo

Ann

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 –

D n v nn nv on n

no o

n o

oo o o n v n n

nv o

B on

B

n o on

s pr s n s propos or r s r pro r o b op on pp on o r n ron n s o rn n – s b s n o s o s n r on s n or n propos ns o s ob s–

n s on s on pr s n so o os n n propos s on ss on o r p s ons on so s ss on pon po o or o p r r p s s s s n s s n ss– s op s por n s n n b s o r po n n r prop r s s n o s s s –

n r bo s n on p r or s o prob o rn n – p

po n s – – o

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 –

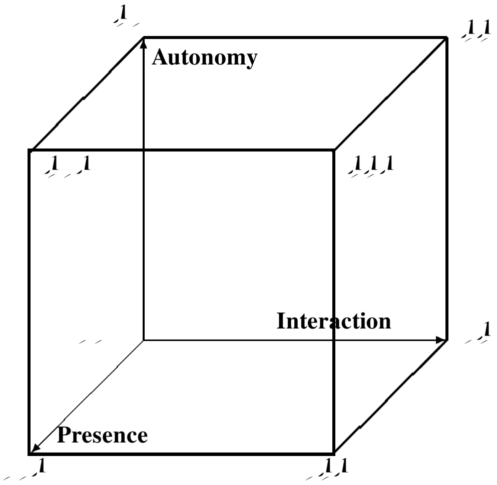


Figure 1: A p ro Z r pp –

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 s on 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 nb p n n E n or s

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

[illegible] nn n

ns n B r 1 ons r o r p s o 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 o 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 y or
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 r r s s n pr n p s n s n on n on on s n o rs ons r s n n p s so r s r – n s s n pr n p s n r r sp n s on o n r o so or –

n

n r or 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 r n r prop r s s s s s pro o
- ons r r r s s n o rs n o rs n propos or rn r pr s n ons s n r or or n s so E s
- s s n ns ons r rr n o rs n ns n ns n B r or r s o pr s n r s r
- s n r s s or Es ns n B r propos s – o –

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

r o o s o b – – by n o on rsy m rn r o p or s – r no b b p m n n – n – – r b n s o pro n p op n s o

v 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 v 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 v n

n r prop r s b n n s r

- s 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 v r n o s n prob s–For r o o s v b v o pro o r s b or s r o r p s v p n rs n n o prob s s–
-

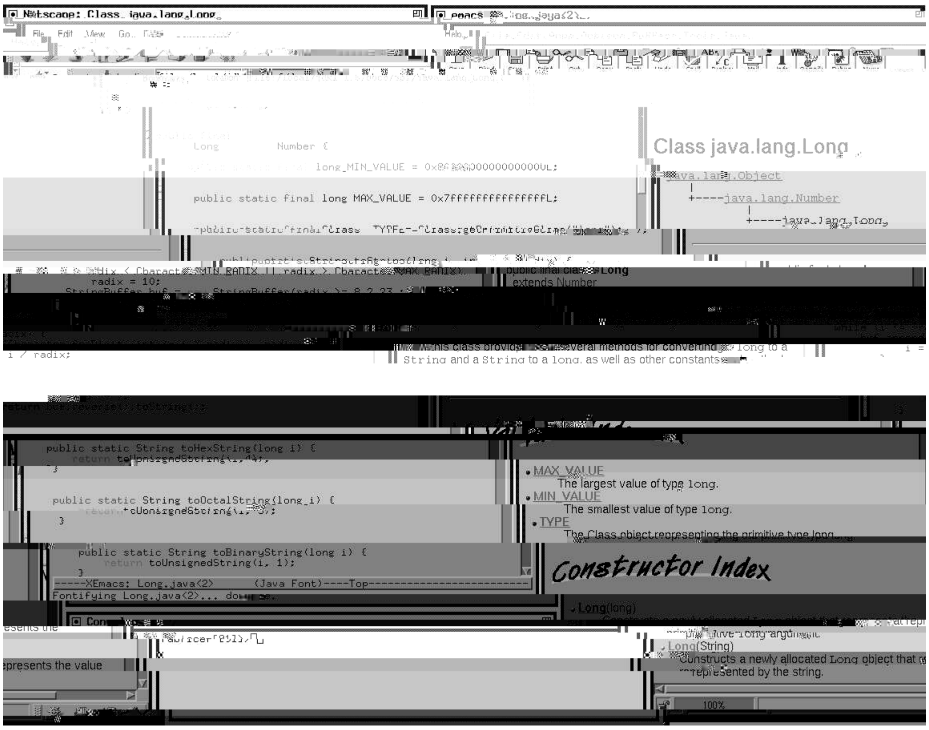
ropo os – 1 – r n ron n s n s n

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

n ows E — — 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 n n n wo n
o o w o o n v v
ow
o
oo o o n v o n n
nv o
B on
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) {
    return toUnsignedString(i, 4);
}

public static String toOctalString(long i) {
    return toUnsignedString(i, 3);
}

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

Class java.lang.Long

java.lang.Object
   |
   +----java.lang.Number
           |
           +----java.lang.Long

public final class Long
extends Number

This class provides several methods for converting a long to a String and a String to a long, as well as other constants

- 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(long)
- 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 –

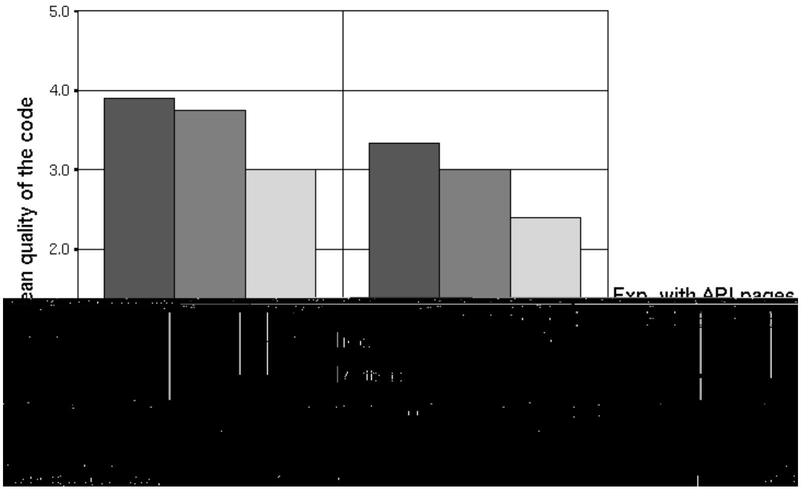
r b	on b r	on b rFor
o	1 s	1 s
o–o p s v ns r n	– p s	– p s
o–o p s v n pro r n	– p s	– p s
o o	–	–
r n o r s rs		
b o o pon n s		L
n o r s	–	–

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



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 o 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 b s rs rs on o o pon n s r p on o on A o n on–Y s b ss s 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
- 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 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 s s s rn poss b 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 s o p n on oo s o n s b r n n s r o s q n on b 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 s n ro p r n_'s r n r r s s p– s r no p nn rs b b n n p on n r ons s–

n n n o

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

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

n op n o p r so n s so o s or p o rn s r n q s or o n ons s–

A n

A

r on b r ss b r s n A ss–

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

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

A

r s on s ss s s n n r n r' pro r –

- s b s or o on b r ob s
- r n 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– 1 –– r s on n n o n n on _’ n r

n ows 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

n v n
n v
B n
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 s p p r r o n o v

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 Broo 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
           ▼r  _’  n  r sor  n      _’
           r
           n   _          __s
           b bb  sor __s   or   __s –

n   _      s op [] –

n   _          [   |   s ]
           ▼r  _’  n  r sor  n      _’
           r      ▼
           n   _        ▼        s –

b bb  sor   or    __s   or    __s
       r  _sor       or   __s –

b bb  sor  __s   or    __s
           s▼  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 ] –

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

s▼  p [Z|   s ] [Z|   s 1]
           s▼  p    s    s 1–
```

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

s sr o sr r n or on–Fn onro oy r ons s o b b ponsy r r rs on sp –

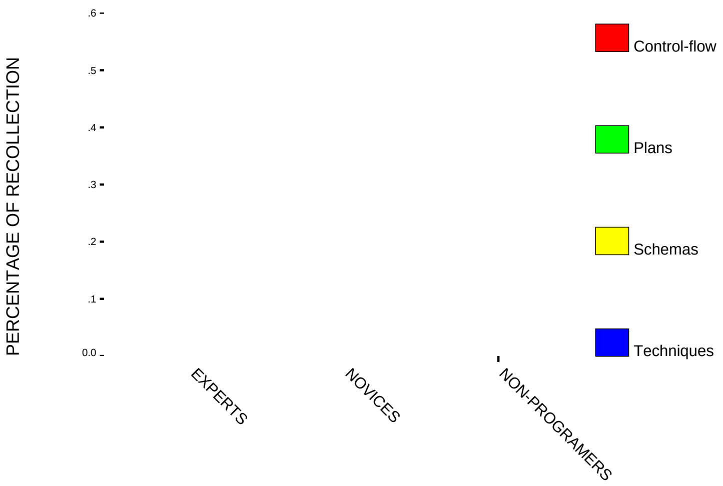
Fn s p r n s n s n on o pro r s' n on s s _' rs ons o s pro r s o b pr s n o s b s– r r o s s_' s pro r s s s r o on s b nb –

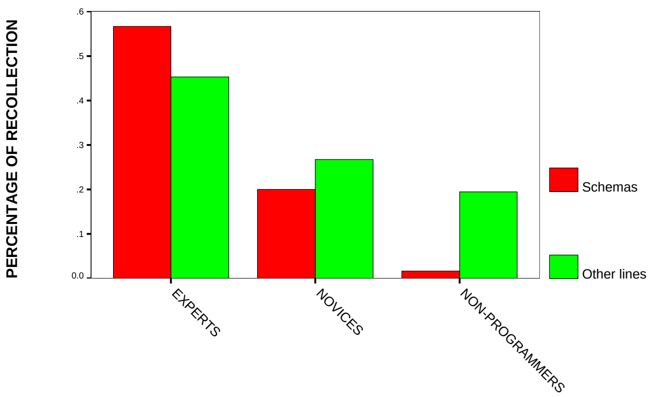
pro r r s b s o s p r n p r or r s r s ss ons– n s ss on y r n r op o p r n pro r n y r s o s n or s – s s p r o s n s– A r s s b s y r n n s o r n y r oyn y o r b r o pro r –Fn s s b s s no r p r o o n s o yr oyn s or p n on o y or n o pro r o s– s s s y r o oyn s propor ons s s or nb p r n– on ro ro p o oy s r n pro r – y r no ns r o o pr n b on o or s pro r s–A so y r no s o yr oyn n p n on o y pro r s o–

As s y s p n n p p r r s o y s n yr 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 y 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 y s or r s b – s ns n s y r ons r s orr r s b yro rb op o pro r o or s s ns oy r o s o s sp s n n n on y 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 y r n n b y s on r n ro pro r y s o on n o on y s no ons r s n rror–

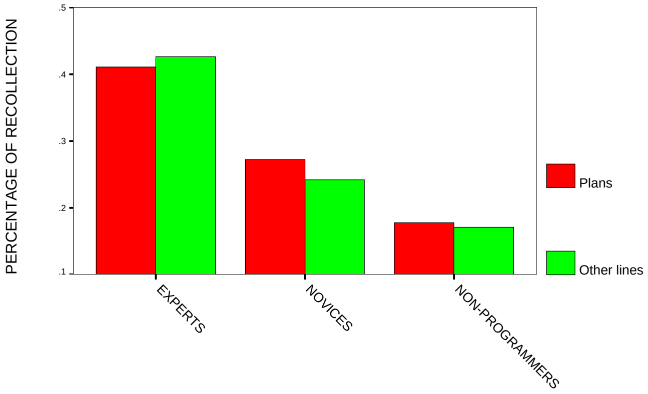
As n on b or s r r ns n s o prs s r n sy o b s r ro s r n s o pro r – n r o on o y o ns n s y s ons r s s ss r o on– or p o p r r ns n y s orr yr n oyn s ns n y s no ons r s orr r – s s r r r or r o on o ns n s y s ons r s ppropr b s s s s n r s ny s r r s s n s r r n o pro r rs– pro r rs' o n o pro r s n on y 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 y 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 ns q n o_'r s o s'_'ob ns n r _' n_'ob ns _' y r s r n s b s' s r p on– n r s ns y r n o n y s ons r orr –A s r r r y s s or o r yo pro r s–

o s p r n y s n s n r p r s– rs p r y s ss r n n n n on o pro r b yo ro ps o pro r rs– s on p r y s on rn y 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 ono 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 rn oro o onors sn nsos



F r 7 rn oro o onoro sr rsopnsn nsos

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

As r o p r sons b v 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

n ons r n on b bb sor pro r s s r o sor pro r nb s s
r b s s o os ob n 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 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 n n s n n s pro r o pr ns on
n o or n o r or s 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 –

r r 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 –

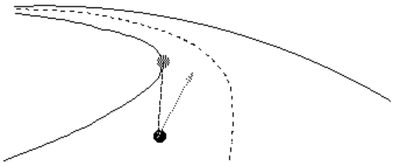
r n – – B – – E– r r – – – rs n n n sr p o o s –
n son – – pp r – o o E– E s–
pp– or oo –Ab –

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 – – ss 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

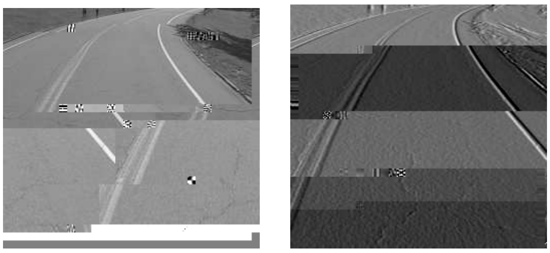


F r 1 n n on

s n r os o v 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 n r s s–

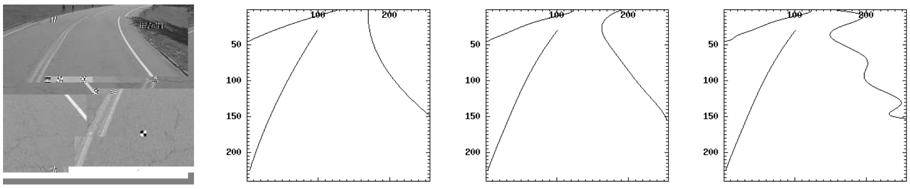
r n n s n ro n s p p r s s o v s b s n r b pro ss n n q s n s s n o pro ss s q n s v s n r s s s ov n n s ro F r n – s q n s on n n or s n r s s s ov n n F r n so b pro ss n pro s r son b r s s–

A n n po n or s o on v r r r's r on o 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 rro v n s r's rr n n n s n s ov s r r's r on o v o s n n po n–



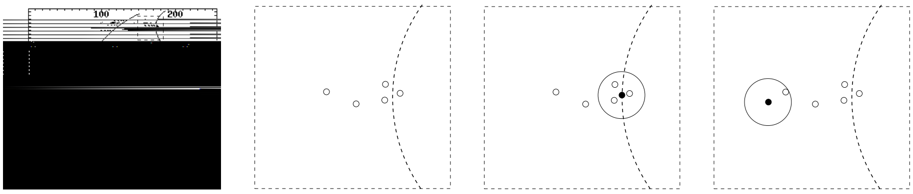
F r oo n n A s D r n n

o n b o r n s rs r o r os o o



b

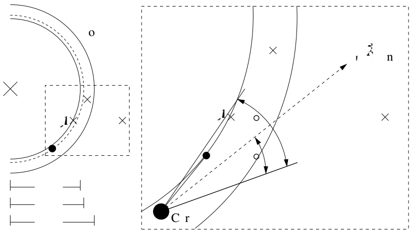
F r D r o o no

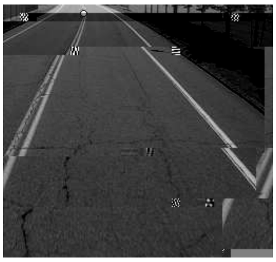


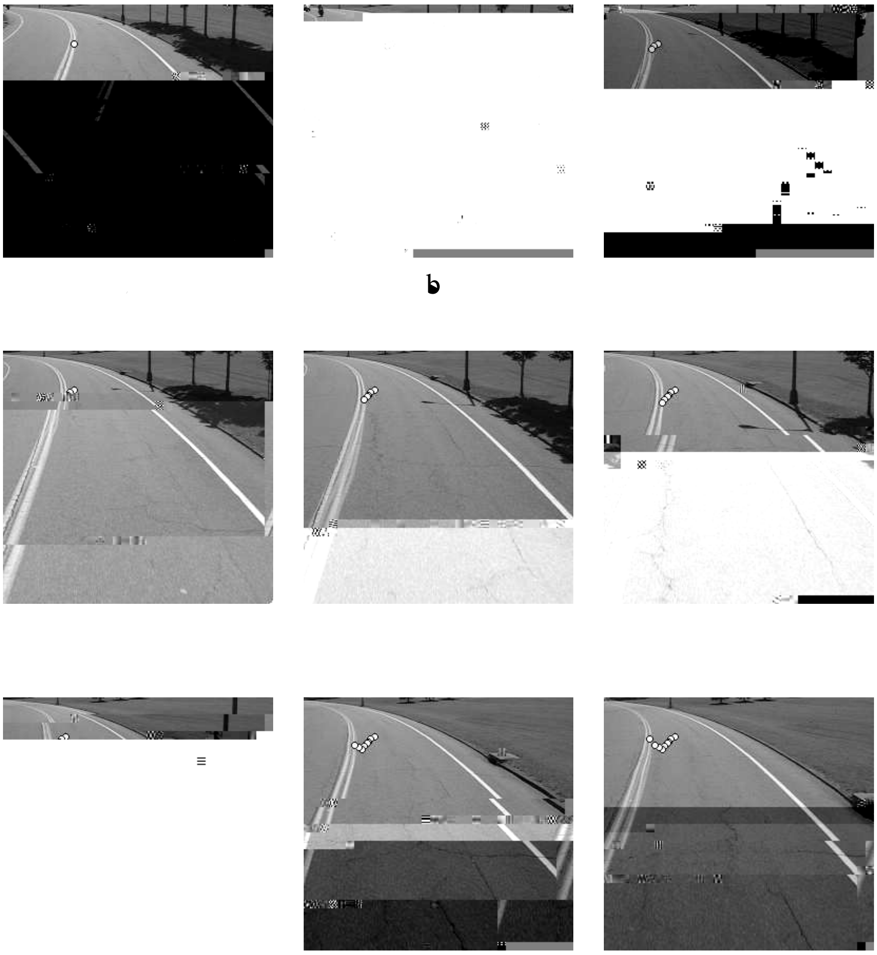
b

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 n n F r 1 s po n n r r's r on o n r nn r b n o ro o


o
n
C r





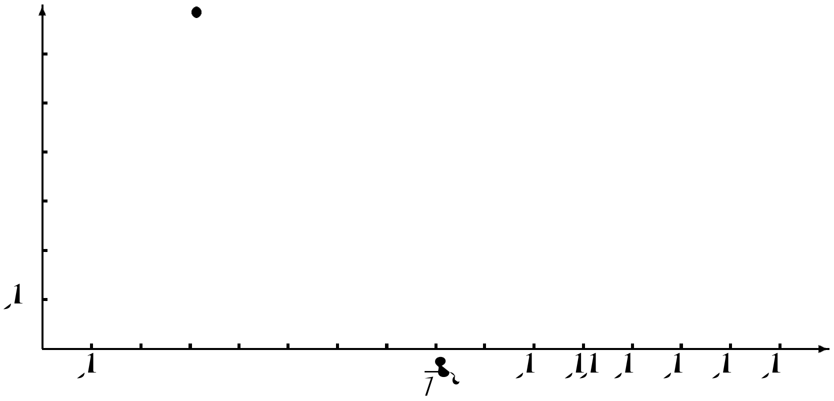
F r C s r n o n n o n s

v n n on

s q n nF r 7 s ows r n or s no r s r o s n b ro n n pon s– ro s ows wo n n pon s w o b o ow b r r r o

F r 7 r on n n ons

p r or n o n n pon r n b n r n r s n r br on–
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

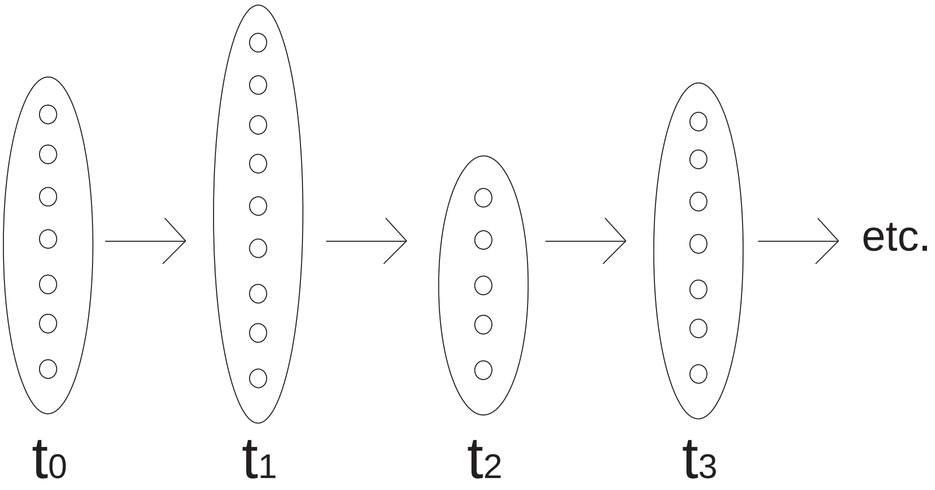


o r D– 1 – p p p n r pos on n r– –r p– obo s
ns C rn on n rs sb r A 1 1 A–

n r F– & o r 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 – –

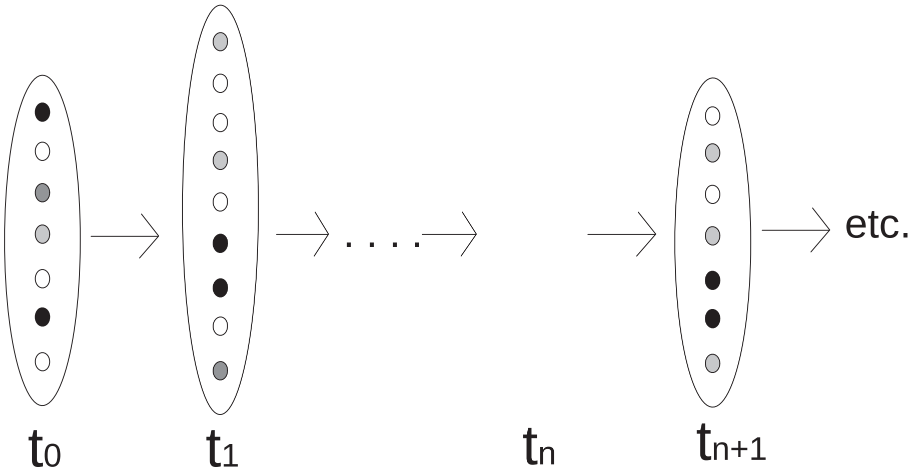
nown n n w so ons b s so on n r or w r s n s r sp o n so on o r prob s no on r s o s r sp s w r now w so on s b s ⊣ 6w r w s r n s s r or on s s prob n s o s r or wo b s – s no w o nown w r now b s so on– r or w w n o n on o s r pro ss s s b s on n s o

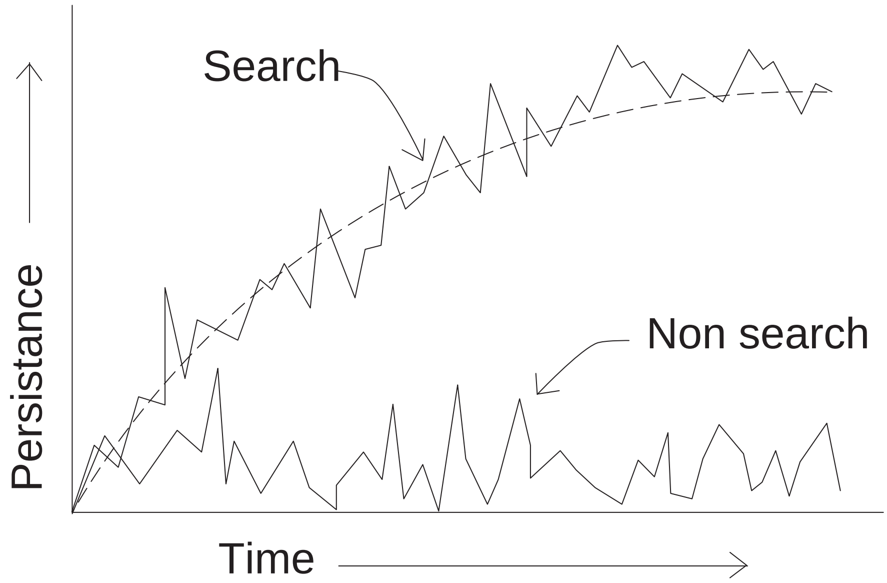


F r 1 s r r o n s r –

s r 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–

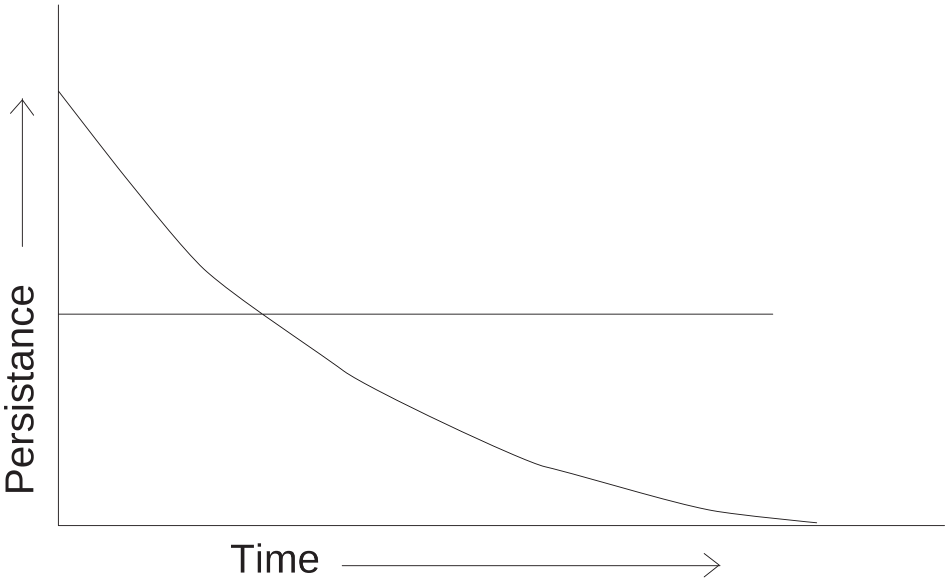
A s n n sp o s r pro ss s or r nor s s s o po n s ro w n n so on w b n r – os s r or s s n s n ro pr o s po n s o p r r s r r on– ow r os o no r b r w o o s or r – ns or s p s b

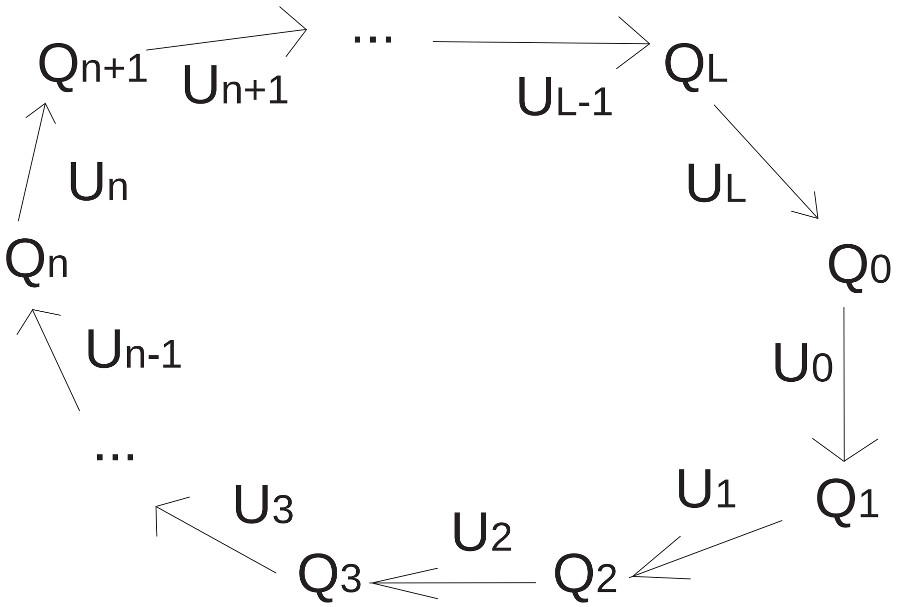

etc.
t_0
t_1
t_n
t_{n+1}



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

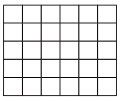
os por n s r n o pro ss w no n o s n on n n r w pro ss o b r on n n s n s p or n n s p n r pp w oo– n s o b r on n n s n s p s w on r n on n w r s r s n p


Persistance
Time

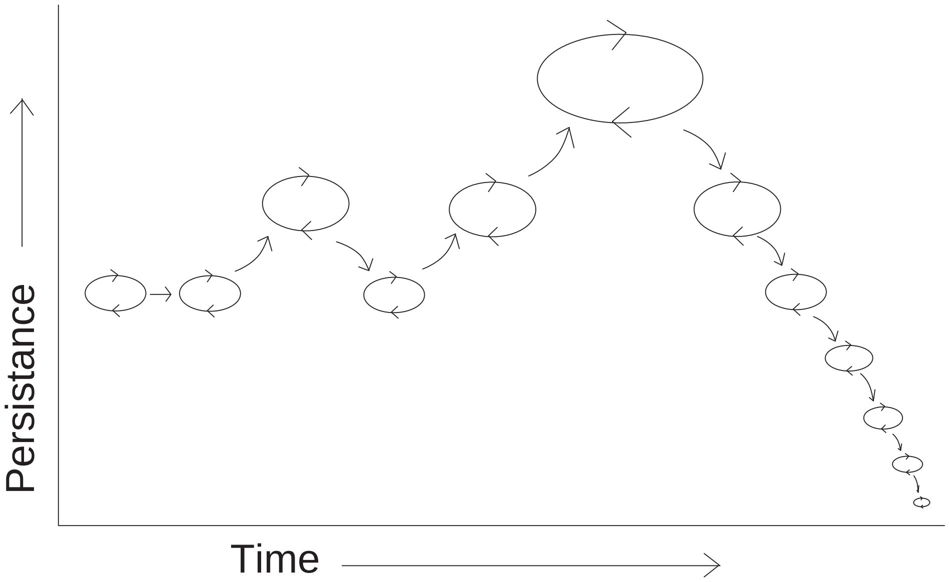

Qn+1
Un+1
...
UL-1
QL
UL
Un
Qn
Q0
U0
Un-1
...
U1
Q1
U3
U2
Q3
Q2

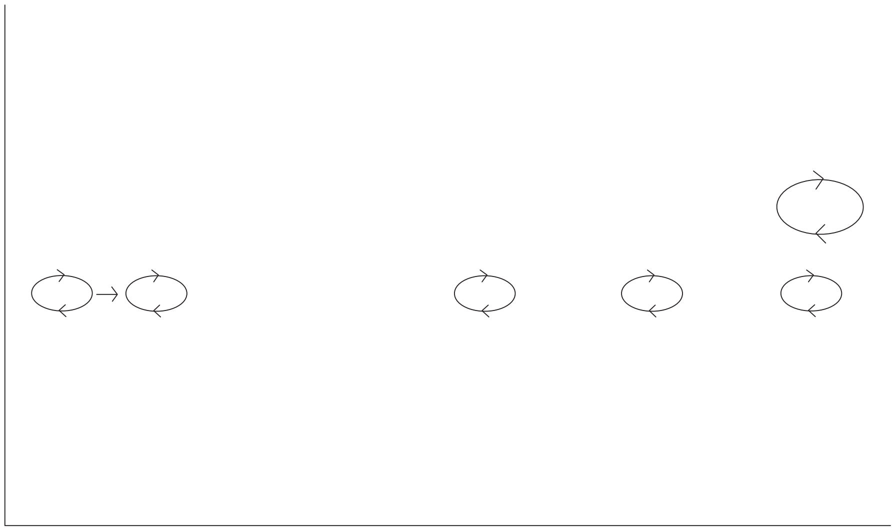
F r or s r r o C rs s n on b C

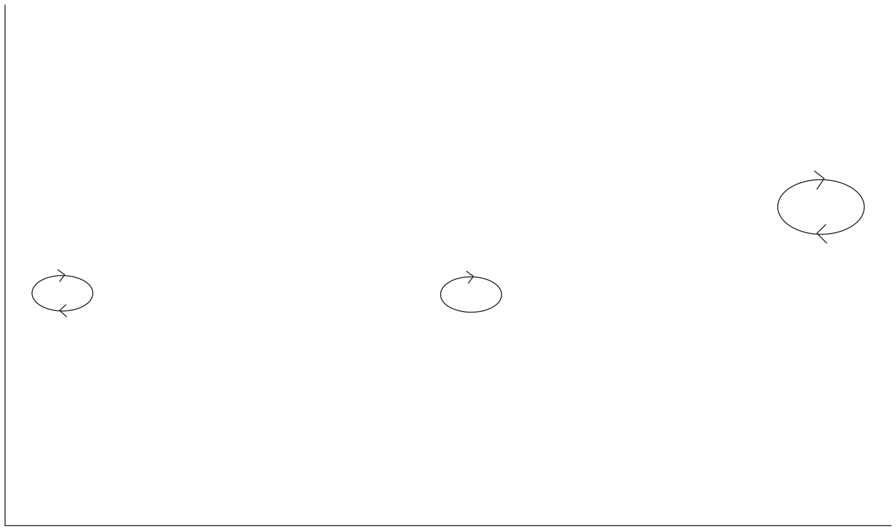
o s s o ows



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 w n o s opo s s o o b s n n s s n s ppor s r pro ss s r b ow n pon n row 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 An A on o Av o o

n Dv
n o n o

oo o on 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 s n n n s or o n o on

pr n n ow nb 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–F n s b s v r o n or r o bor o s or br v o o r n pro n s n v v o b s o r n s n o s or r o s –

Stage 1 A s b s v r s o o p nn orr s

nn o onn

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 – p – n s or s or r ro ps r – s – s n s – or os n r ro ps r sp –

##

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 – p– –A o r s no s n n r n n ro ps on pr n on s r – D ps r s s n n r n n ro ps on pos n on n s r – 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 r on – 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–

oo	An		n ss		pp n ss	
	r n on	os n on	r n on	os n on	r n on	os n on
	–	– –	– –	–	– –	– –

pp n ss r n s so s n n ro p r n n r on F p – 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 F p – 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 s o r n pp n ss s– ro p n r on s s n n F 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

F 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 y orr rs s n n r s s o b r n s pp n n o n o non y orr rs s so s & Bor o 1 – 6y r r p n on s b s on y orr 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 y orr 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 y o pp n r r n r r r sons y n n y o no pp n D nn n & rp 1 7 – 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 7 Boy r 1 7 s 1 7 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 7 – 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 y orr 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 – 7 – 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 srop worr n prson n q n prs r r s s r so srop sn pro ss– b –

D C p on – rr – & D son – o r rs so worr E n or worr n n n ss p r ons r s– rson & n D r n s –

D C bb – & C ron C– C srop worr n s n on o n s n prob so n on n – Con r p & s r –

D C s & C p o – p no no o o non p o o worr 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 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 –