Using Statistical Distributions to Generate Random Test Data

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Overview

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What is Software Testing?

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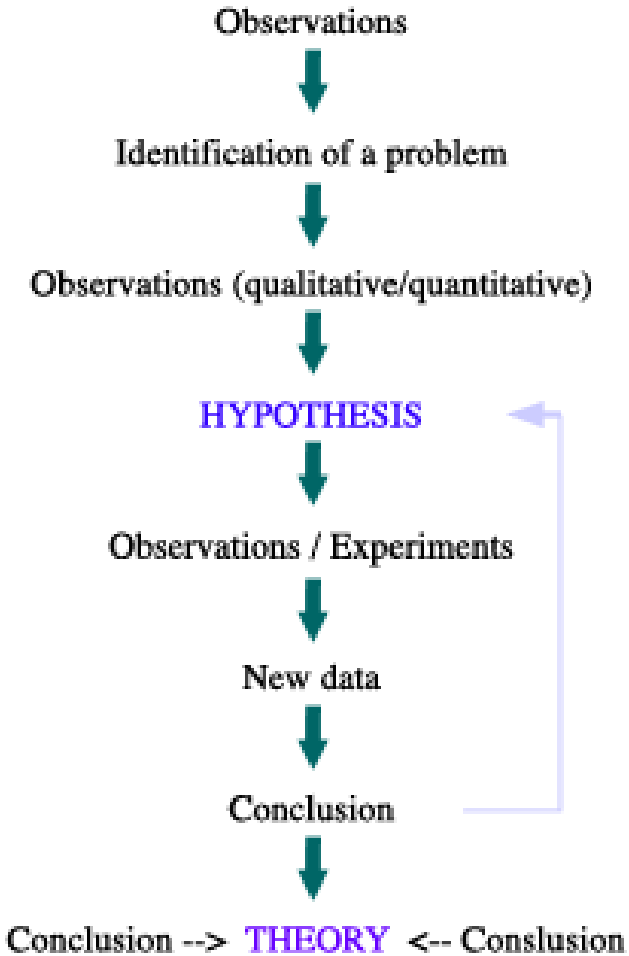

Why is it so hard?

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```
files/xoklpenyj/xvrr/xmnyjnm/rrm.exe
files/xoklpenyj/xvrr/xmnyjnm/vvfpm.c
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files/xoklpenyj/xvrr/xn/isolg.h
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files/xqftrpq/gcq.tgz
files/xqftrpq/vs/lpfqt.h
files/xqftrpq/vs/qywyn.c
files/xqftrpq/vs/qywyn.h
```

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cis415-2 [Running]

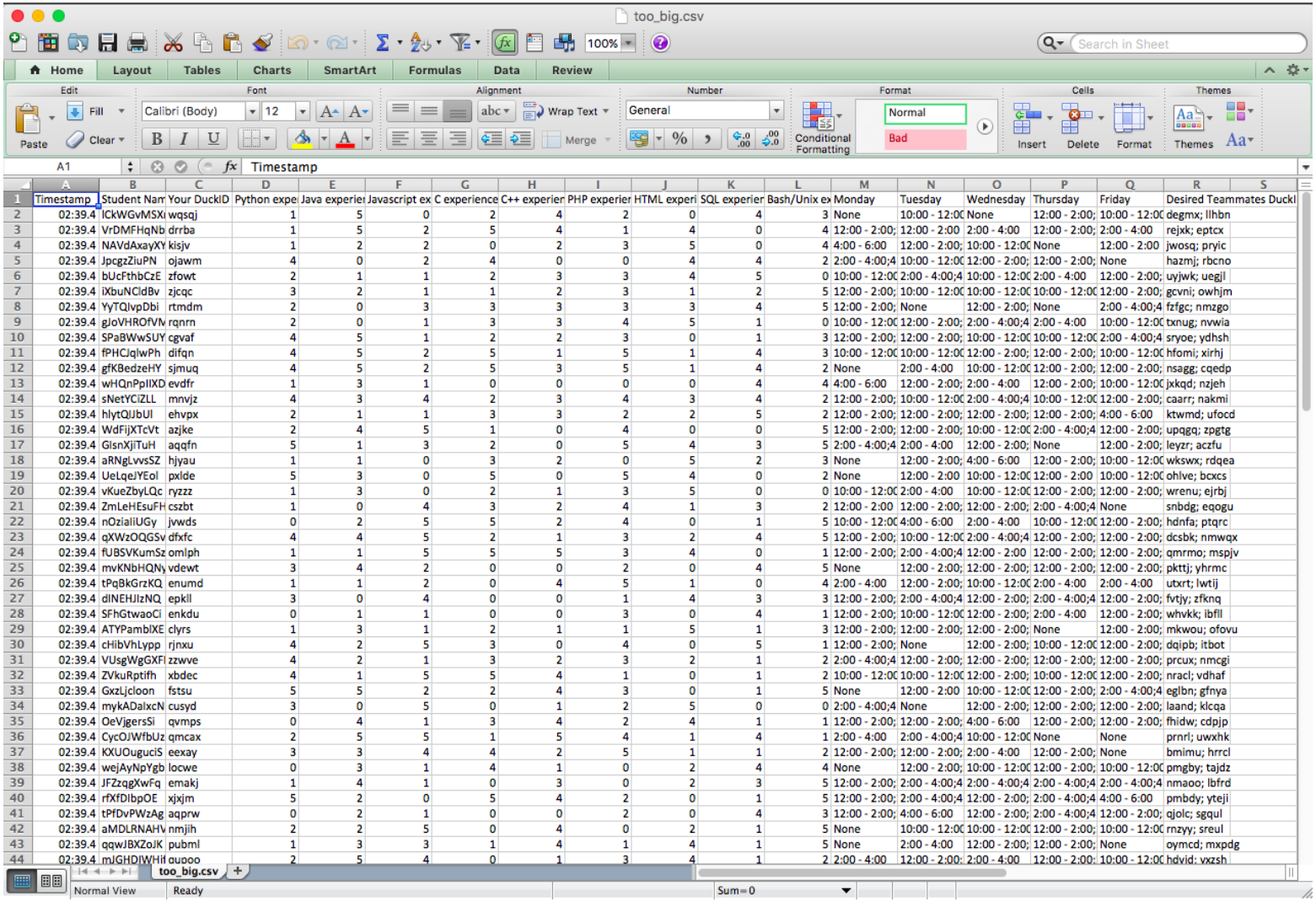
Applications | Terminal - cis415@cis41... | 15:37 | cis415

Terminal - cis415@cis415-arch:~/uoregon-cis415/project2

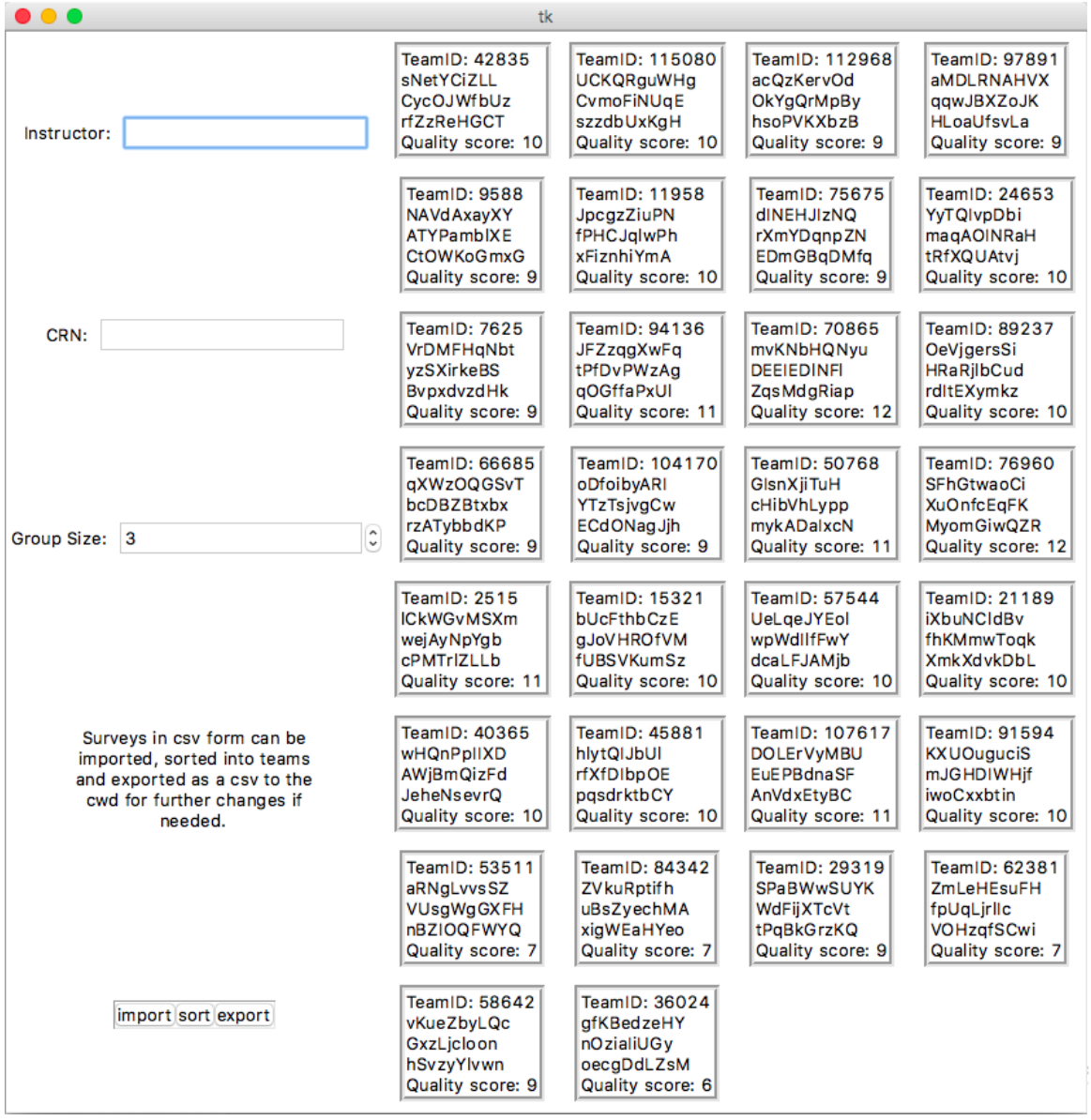
File Edit View Terminal Tabs Help

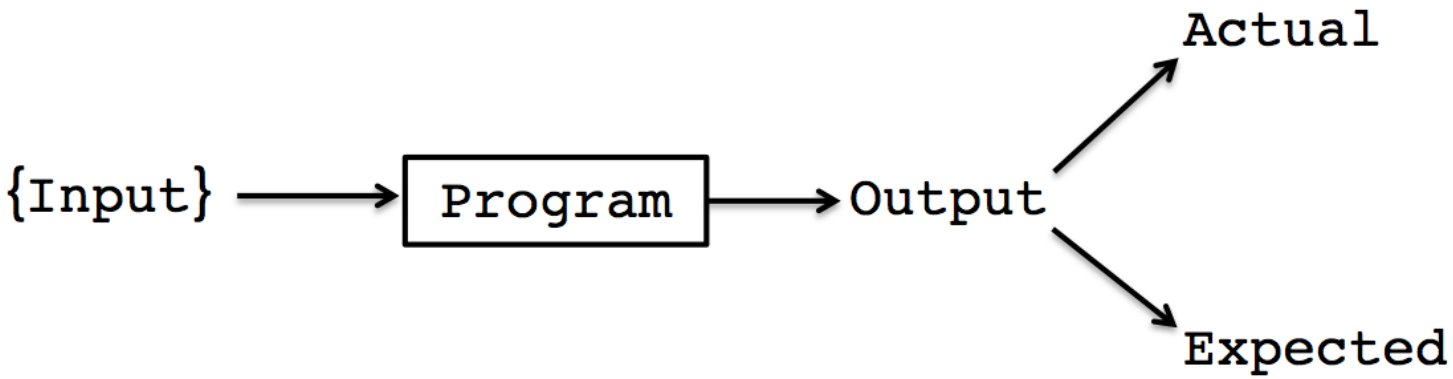
```
Info: application 7 has queued write to sector 3592 (blocking)
Info: application 8 has acquired a sector descriptor.
Info: application 8 is queueing write to sector 3987
Info: application 8 has queued write to sector 3987 (blocking)
Info: application 1 has acquired a sector descriptor.
Info: application 1 is queueing write to sector 1175
Info: application 1 has queued write to sector 1175 (nonblocking)
[Device> sector 4004 successfully written by process 2
Info: application 9 has acquired a sector descriptor.
Info: application 9 is queueing read of sector 3854
Info: application 9 has queued read of sector 3854 (blocking)
Info: application 5 has acquired a sector descriptor.
Info: application 5 is queueing write to sector 1111
Info: application 5 has queued write to sector 1111 (nonblocking)
Info: application 3 has acquired a sector descriptor.
Info: application 3 is queueing read of sector 1537
Info: application 3 has queued read of sector 1537 (nonblocking)
Info: application 9 has acquired a sector descriptor.
Info: application 9 is queueing write to sector 3402
Info: application 9 has queued write to sector 3402 (blocking)
Info: application 8 has acquired a sector descriptor.
Info: application 8 is queueing read of sector 3175
Info: application 8 has queued read of sector 3175 (blocking)
Info: application 3 (writer) write to sector 2192 was successful
[Device> sector 1091 successfully written by process 10
Info: application 5 (reader) read from sector 1477 was successful
Info: application 5 (reader) has released a sector descriptor.
Info: application 6 has acquired a sector descriptor.
Info: application 6 is queueing read of sector 821
Info: application 6 has queued read of sector 821 (nonblocking)
Info: application 2 (writer) write to sector 4004 was successful
[Device> sector 3592 successfully written by process 7
Info: application 10 (reader) read from sector 1331 was successful
Info: application 10 (reader) has released a sector descriptor.
Info: application 2 has acquired a sector descriptor.
Info: application 2 is queueing read of sector 117
Info: application 2 has queued read of sector 117 (nonblocking)
[Device> sector 3854 successfully read by process 9
[Device> sector 1537 successfully read by process 3
[Device> sector 3987 successfully written by process 8
Info: application 7 (writer) write to sector 3592 was successful
```

Left ⌘



Timestamp	Student Nam	Your DuckID	Python expe	Java experier	Javascript ex	C experience	C++ experier	PHP experier	HTML experi	SQL experier	Bash/Unix ex	Monday	Tuesday	Wednesday	Thursday	Friday	Desired Teammates Duckl
02:39.4	lCkWGvMSXi	wqsqj	1	5	0	2	4	2	0	4	3	None	10:00 - 12:0	None	12:00 - 2:00;	10:00 - 12:0	degmx; llhbn
02:39.4	VrDMFHqNb	drrba	1	5	2	5	4	1	4	0	4	12:00 - 2:00;	12:00 - 2:00	2:00 - 4:00	12:00 - 2:00;	2:00 - 4:00	rejxk; eptcx
02:39.4	NAVdAxayXY	kisjv	1	2	2	0	2	3	5	0	4	4:00 - 6:00	12:00 - 2:00;	10:00 - 12:0	None	12:00 - 2:00	jwosq; pryic
02:39.4	JpcgzZiuPN	ojawm	4	0	2	4	0	0	4	4	2	2:00 - 4:00;4	10:00 - 12:0	12:00 - 2:00;	12:00 - 2:00;	None	hazmj; rbcno
02:39.4	bUcFthbCzE	zfowt	2	1	1	2	3	3	4	5	0	10:00 - 12:0	2:00 - 4:00;4	10:00 - 12:0	2:00 - 4:00	12:00 - 2:00;	uyjwk; uegjl
02:39.4	iXbuNCldBv	zjcqc	3	2	1	1	2	3	1	2	5	12:00 - 2:00;	10:00 - 12:0	10:00 - 12:0	10:00 - 12:0	12:00 - 2:00;	gcvni; owhjm
02:39.4	YyTQlvpDbi	rtmdm	2	0	3	3	3	3	3	4	5	12:00 - 2:00;	None	12:00 - 2:00;	None	2:00 - 4:00;4	fzfgc; nmzgo
02:39.4	gJoVHROfVM	rqnrn	2	0	1	3	3	4	5	1	0	10:00 - 12:0	12:00 - 2:00;	2:00 - 4:00;4	2:00 - 4:00	10:00 - 12:0	txnug; nvwia
02:39.4	SPaBWwSUY	cgvaf	4	5	1	2	2	3	0	1	3	12:00 - 2:00;	12:00 - 2:00;	10:00 - 12:0	10:00 - 12:0	2:00 - 4:00;4	sryoe; ydhsh
02:39.4	fPHCJqlwPh	difqn	4	5	2	5	1	5	1	4	3	10:00 - 12:0	10:00 - 12:0	12:00 - 2:00;	12:00 - 2:00;	10:00 - 12:0	hfomi; xirhj
02:39.4	gfKBedzeHY	sjmuq	4	5	2	5	3	5	1	4	2	None	2:00 - 4:00	10:00 - 12:0	12:00 - 2:00;	12:00 - 2:00;	nsagg; cqedp
02:39.4	wHQnPpIIXD	evdfr	1	3	1	0	0	0	0	4	4	4:00 - 6:00	12:00 - 2:00;	2:00 - 4:00	12:00 - 2:00;	10:00 - 12:0	jxkqd; nzjeh
02:39.4	sNetYCiZLL	mnvjz	4	3	4	2	3	4	3	4	2	12:00 - 2:00;	10:00 - 12:0	2:00 - 4:00;4	10:00 - 12:0	12:00 - 2:00;	caarr; nakmi
02:39.4	hlytQlJbUl	ehvpx	2	1	1	3	3	2	2	5	2	12:00 - 2:00;	12:00 - 2:00;	12:00 - 2:00;	12:00 - 2:00;	4:00 - 6:00	ktwmd; ufocd
02:39.4	WdFijXTcVt	azjke	2	4	5	1	0	4	0	0	5	12:00 - 2:00;	12:00 - 2:00;	10:00 - 12:0	2:00 - 4:00;4	12:00 - 2:00;	upqgq; zpgtg
02:39.4	GlsnXjiTuH	aqqfn	5	1	3	2	0	5	4	3	5	2:00 - 4:00;4	2:00 - 4:00	12:00 - 2:00;	None	12:00 - 2:00;	leyzr; aczfu
02:39.4	aRNgLvvsSZ	hjyau	1	1	0	3	2	0	5	2	3	None	12:00 - 2:00;	4:00 - 6:00	12:00 - 2:00;	10:00 - 12:0	wkswx; rdqea
02:39.4	UeLqeJYEol	pxlde	5	3	0	5	0	5	4	0	2	None	12:00 - 2:00	10:00 - 12:0	12:00 - 2:00	10:00 - 12:0	ohlve; bcxcs
02:39.4	vKueZbyLQc	ryzzz	1	3	0	2	1	3	5	0	0	10:00 - 12:0	2:00 - 4:00	10:00 - 12:0	12:00 - 2:00;	12:00 - 2:00;	wrenu; ejrbj
02:39.4	ZmLeHEsuFH	cszbt	1	0	4	3	2	4	1	3	2	12:00 - 2:00	12:00 - 2:00;	12:00 - 2:00;	2:00 - 4:00;4	None	snbdg; eqogu
02:39.4	nOzialiUGy	jvwds	0	2	5	5	2	4	0	1	5	10:00 - 12:0	4:00 - 6:00	2:00 - 4:00	10:00 - 12:0	12:00 - 2:00;	hdnfa; ptqrc
02:39.4	qXWzOQGSv	dfxfc	4	4	5	2	1	3	2	4	5	12:00 - 2:00;	10:00 - 12:0	2:00 - 4:00;4	12:00 - 2:00;	12:00 - 2:00;	dcsbk; nmwqx
02:39.4	fUBSVKumSz	omlph	1	1	5	5	5	3	4	0	1	12:00 - 2:00;	2:00 - 4:00;4	12:00 - 2:00	12:00 - 2:00;	12:00 - 2:00;	qmrmo; mspjv
02:39.4	mvKNbHQNy	vdewt	3	4	2	0	0	2	0	4	5	None	12:00 - 2:00;	12:00 - 2:00;	12:00 - 2:00;	12:00 - 2:00;	pkttj; yhrmc
02:39.4	tPqBkGrzKQ	enumd	1	1	2	0	4	5	1	0	4	2:00 - 4:00	12:00 - 2:00;	10:00 - 12:0	2:00 - 4:00	2:00 - 4:00	utxrt; lwtij
02:39.4	dlNEHJIzNQ	epkll	3	0	4	0	0	1	4	3	3	12:00 - 2:00;	2:00 - 4:00;4	12:00 - 2:00;	2:00 - 4:00;4	12:00 - 2:00;	fvtjy; zfknq
02:39.4	SFhGtwaoCi	enkdu	0	1	1	0	0	3	0	4	1	12:00 - 2:00;	10:00 - 12:0	12:00 - 2:00;	2:00 - 4:00	12:00 - 2:00;	whvkk; ibfll
02:39.4	ATYPamblXE	clyrs	1	3	1	2	1	1	5	1	3	12:00 - 2:00;	12:00 - 2:00;	12:00 - 2:00;	None	12:00 - 2:00;	mkwou; ofovu
02:39.4	cHibVhLypp	rjnxu	4	2	5	3	0	4	0	5	1	12:00 - 2:00;	None	12:00 - 2:00;	10:00 - 12:0	12:00 - 2:00;	dqipb; itbot
02:39.4	VUsgWgGXFl	zzwve	4	2	1	3	2	3	2	1	2	2:00 - 4:00;4	12:00 - 2:00;	12:00 - 2:00;	12:00 - 2:00;	12:00 - 2:00;	prcux; nmcgi
02:39.4	ZVkuRptifh	xbdec	4	1	5	5	4	1	0	1	2	10:00 - 12:0	10:00 - 12:0	12:00 - 2:00;	10:00 - 12:0	12:00 - 2:00;	nracl; vdhaf
02:39.4	GxzLjcloon	fstsu	5	5	2	2	4	3	0	1	5	None	12:00 - 2:00	10:00 - 12:0	12:00 - 2:00;	2:00 - 4:00;4	eglbn; gfnya
02:39.4	mykADaIxcN	cusyd	3	0	5	0	1	2	5	0	0	2:00 - 4:00;4	None	12:00 - 2:00;	12:00 - 2:00;	12:00 - 2:00;	laand; klcqa
02:39.4	OeVjgersSi	qvmps	0	4	1	3	4	2	4	1	1	12:00 - 2:00;	12:00 - 2:00;	4:00 - 6:00	12:00 - 2:00;	12:00 - 2:00;	fhidw; cdpjp
02:39.4	CycOJWfbUz	qmcax	2	5	5	1	5	4	1	4	1	2:00 - 4:00	2:00 - 4:00;4	10:00 - 12:0	None	None	prnrl; uwxhk
02:39.4	KXUOuguciS	eexay	3	3	4	4	2	5	1	1	2	12:00 - 2:00;	12:00 - 2:00;	2:00 - 4:00	12:00 - 2:00;	None	bmimu; hrrcl
02:39.4	wejAyNpYgb	locwe	0	3	1	4	1	0	2	4	4	None	12:00 - 2:00;	10:00 - 12:0	12:00 - 2:00;	10:00 - 12:0	pmgby; tajdz
02:39.4	JFZzqgXwFq	emakj	1	4	1	0	3	0	2	3	5	12:00 - 2:00;	2:00 - 4:00;4	2:00 - 4:00;4	2:00 - 4:00;4	2:00 - 4:00;4	nmaoo; lbfrd
02:39.4	rfXfDlbpOE	xjxjm	5	2	0	5	4	2	0	1	5	12:00 - 2:00;	2:00 - 4:00;4	12:00 - 2:00;	2:00 - 4:00;4	4:00 - 6:00	pmbdy; yteji
02:39.4	tPfDvPWzAg	aqprw	0	2	1	0	0	2	0	4	3	12:00 - 2:00;	4:00 - 6:00	12:00 - 2:00;	2:00 - 4:00;4	12:00 - 2:00;	qjolc; sgqul
02:39.4	aMDLRNAHv	nmjih	2	2	5	0	4	0	2	1	5	None	10:00 - 12:0	10:00 - 12:0	12:00 - 2:00;	10:00 - 12:0	rnzyy; sreul
02:39.4	qqwJBXZoJK	pubml	1	3	3	1	4	1	4	1	5	None	2:00 - 4:00	12:00 - 2:00;	12:00 - 2:00;	None	oymcd; mxpdg
02:39.4	mJGHDlWHif	qupoo	2	5	4	0	1	3	4	1	2	2:00 - 4:00	12:00 - 2:00;	2:00 - 4:00	12:00 - 2:00;	10:00 - 12:0	hdvid; vxzsh


tk
Instructor:
CRN:
Group Size: 3
Surveys in csv form can be imported, sorted into teams and exported as a csv to the cwd for further changes if needed.
import
sort
export
TeamID: 42835 sNetYCiZLL CycOJWfbUz rfZzReHGCT Quality score: 10
TeamID: 115080 UCKQRguWHg CvmoFiNUqE szzdbUxKgH Quality score: 10
TeamID: 112968 acQzKervOd OkYgQrMpBy hsoPVKXbzB Quality score: 9
TeamID: 97891 aMDLRNAHVX qqwJBXZoJK HLoaUfsvLa Quality score: 9
TeamID: 9588 NAVdAxayXY ATYPambIXE CtOWKoGmxG Quality score: 9
TeamID: 11958 JpcgzZiuPN fPHCJqlwPh xFiznhiYmA Quality score: 10
TeamID: 75675 dlNEHJlzNQ rXmYDqnpZN EDmGBqDMfq Quality score: 9
TeamID: 24653 YyTQlvpDbi maqAOlNRaH tRfXQUAtvj Quality score: 10
TeamID: 7625 VrDMFHqNbt yzSXirkeBS BvpxdvzdHk Quality score: 9
TeamID: 94136 JFZzqgXwFq tPfDvPWzAg qOGffaPxUl Quality score: 11
TeamID: 70865 mvKNbHQNyu DEElEDINFl ZqsMdgRiap Quality score: 12
TeamID: 89237 OeVjgersSi HRaRjlbCud rdltEXymkz Quality score: 10
TeamID: 66685 qXWzOQGSvT bcDBZBtxbx rzATybbdKP Quality score: 9
TeamID: 104170 oDfoibyARl YTzTsjvgCw ECdONagJjh Quality score: 9
TeamID: 50768 GlsnXjiTuH cHibVhLypp mykADalxcN Quality score: 11
TeamID: 76960 SFhGtwaoCi XuOnfcEqFK MyomGiwQZR Quality score: 12
TeamID: 2515 lCkWGvMSXm wejAyNpYgb cPMTrlZLLb Quality score: 11
TeamID: 15321 bUcFthbCzE gJoVHROfVM fUBSVKumSz Quality score: 10
TeamID: 57544 UeLqeJYEol wpWdlIfFwY dcaLFJAMjb Quality score: 10
TeamID: 21189 iXbuNCldBv fhKMmwToqk XmkXdvkDbL Quality score: 10
TeamID: 40365 wHQnPpIIXD AWjBmQizFd JeheNsevrQ Quality score: 10
TeamID: 45881 hlytQlJbUl rfXfDlbpOE pqsdrktbCY Quality score: 10
TeamID: 107617 DOLErVyMBU EuEPBdnaSF AnVdxEtyBC Quality score: 11
TeamID: 91594 KXUOuguciS mJGHDlWHjf iwoCxxbtin Quality score: 10
TeamID: 53511 aRNgLvvsSZ VUsgWgGXFH nBZlOQFWYQ Quality score: 7
TeamID: 84342 ZVkuRptifh uBsZyechMA xigWEaHYeo Quality score: 7
TeamID: 29319 SPaBWwSUYK WdFijXTcVt tPqBkGrzKQ Quality score: 9
TeamID: 62381 ZmLeHEsuFH fpUqLjrllc VOHzqfSCwi Quality score: 7
TeamID: 58642 vKueZbyLQc GxzLjcloon hSvzyYlvwn Quality score: 9
TeamID: 36024 gfKBedzeHY nOzialiUGy oecgDdLZsM Quality score: 6


{Input}
Program
Output
Actual
Expected

Well if it's so hard why bother?

5

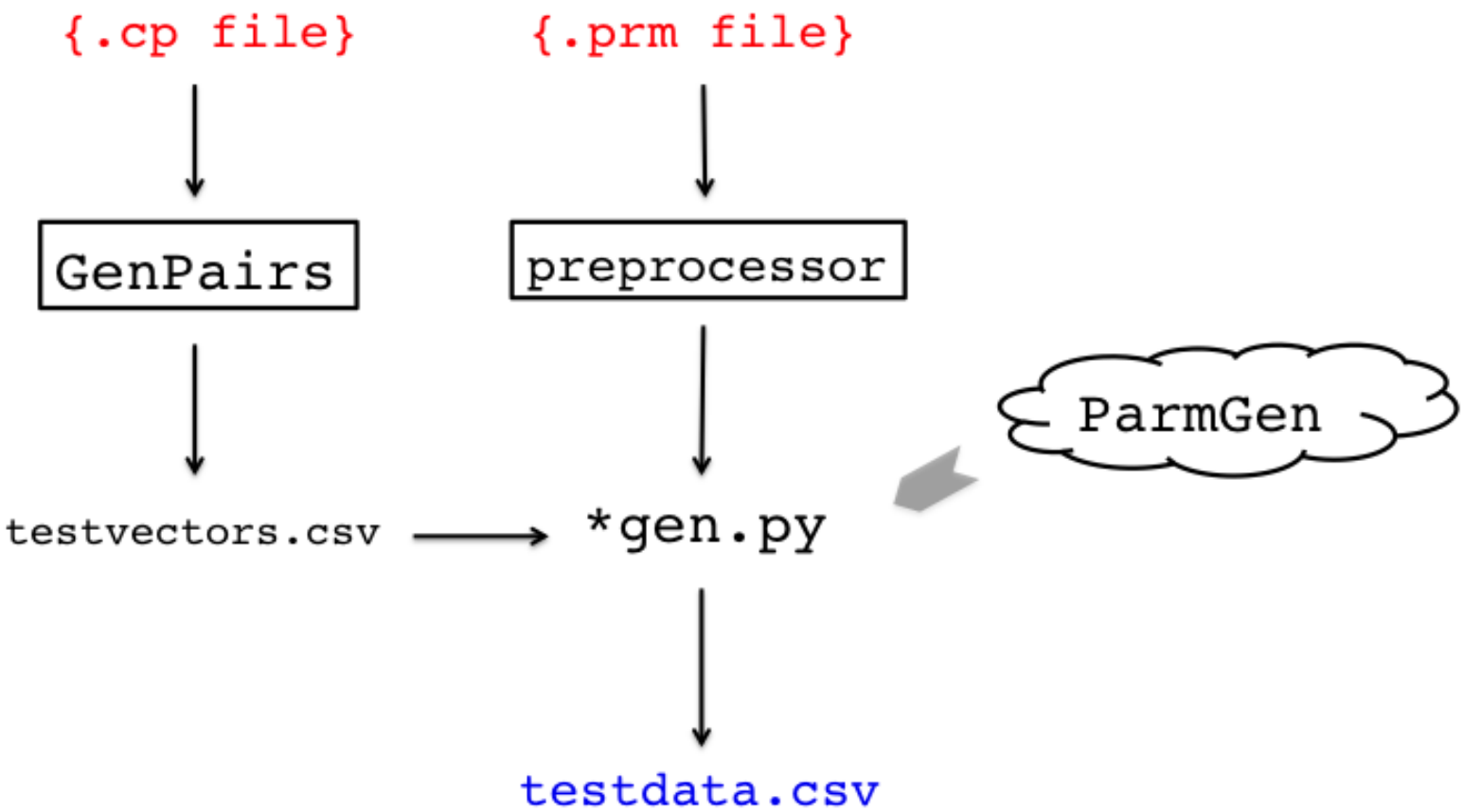
An Investigation of the Therac-25 Accidents

Nancy G. Leveson, University of Washington
Clark S. Turner, University of California, Irvine

Computers are increasingly being introduced into safety-critical systems and, as a consequence, have been involved in accidents. Some of the most widely cited software-related accidents in safety-critical systems involved a computerized radiation therapy machine called the Therac-25. Between June 1985 and January 1987, six known accidents involved massive overdoses by the Therac-25 — with resultant deaths and serious injuries. They have been described as the worst series of radiation accidents in the 35-year history of medical accelerators.[1]

Overview

GenSequence



Goals

- Ease of use - as much end-to-end automation as possible
- Insight into what the input looks like

Overview

NEC
Empowered by Innovation

Pairwise Testing

University of Waterloo

- The total number of all-combination test cases is $2 \times 2 \times 2 = 8$
- However, a subset of four test cases, as shown in Table 9.5, covers all pairwise combinations

Test Case Id	Input X	Input Y	Input Z
TC_1	$True$	0	Q
TC_2	$True$	5	R
TC_3	$False$	0	Q
TC_4	$False$	5	R

Table 9.5: Pairwise test cases for system S.

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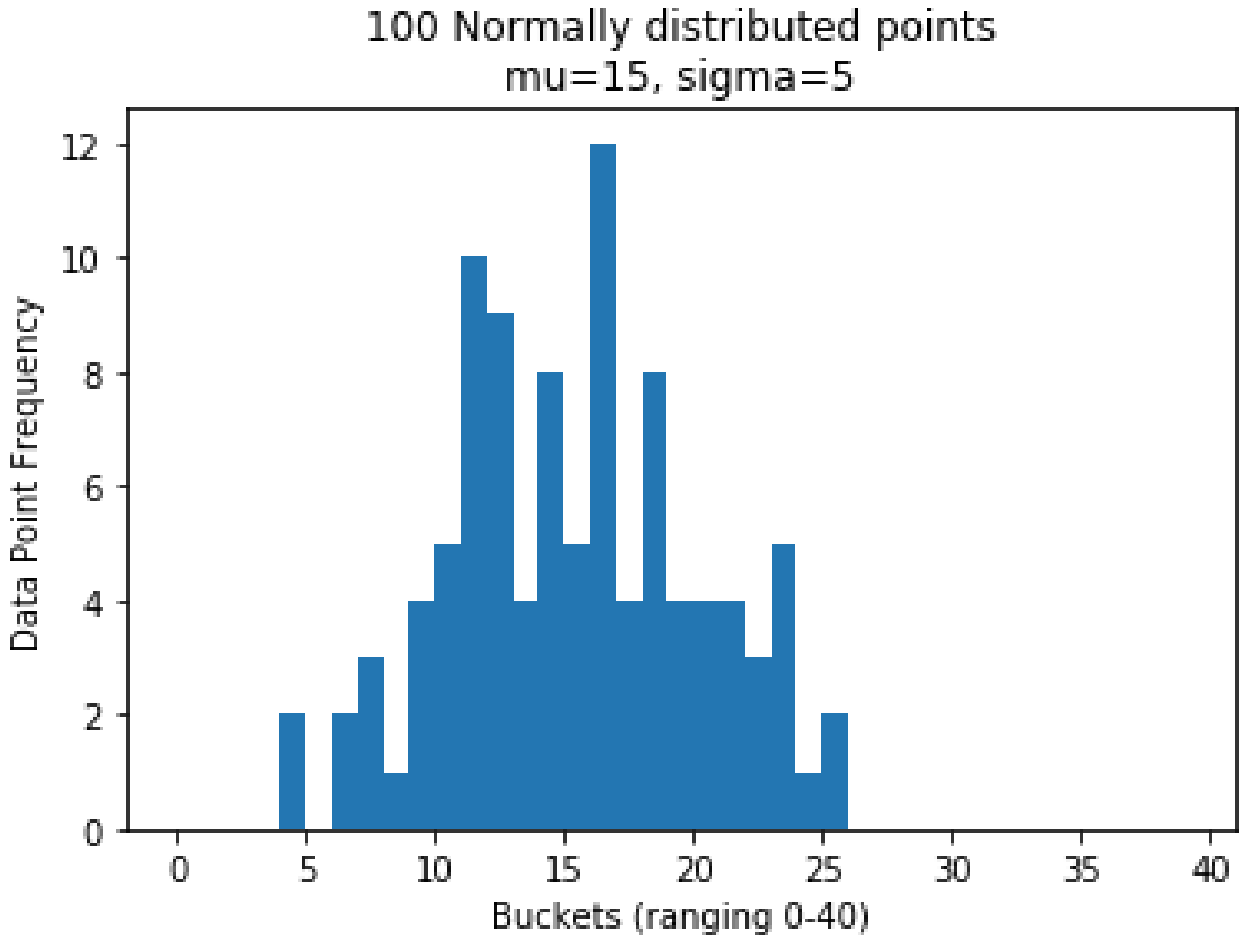
Constrained Randomness

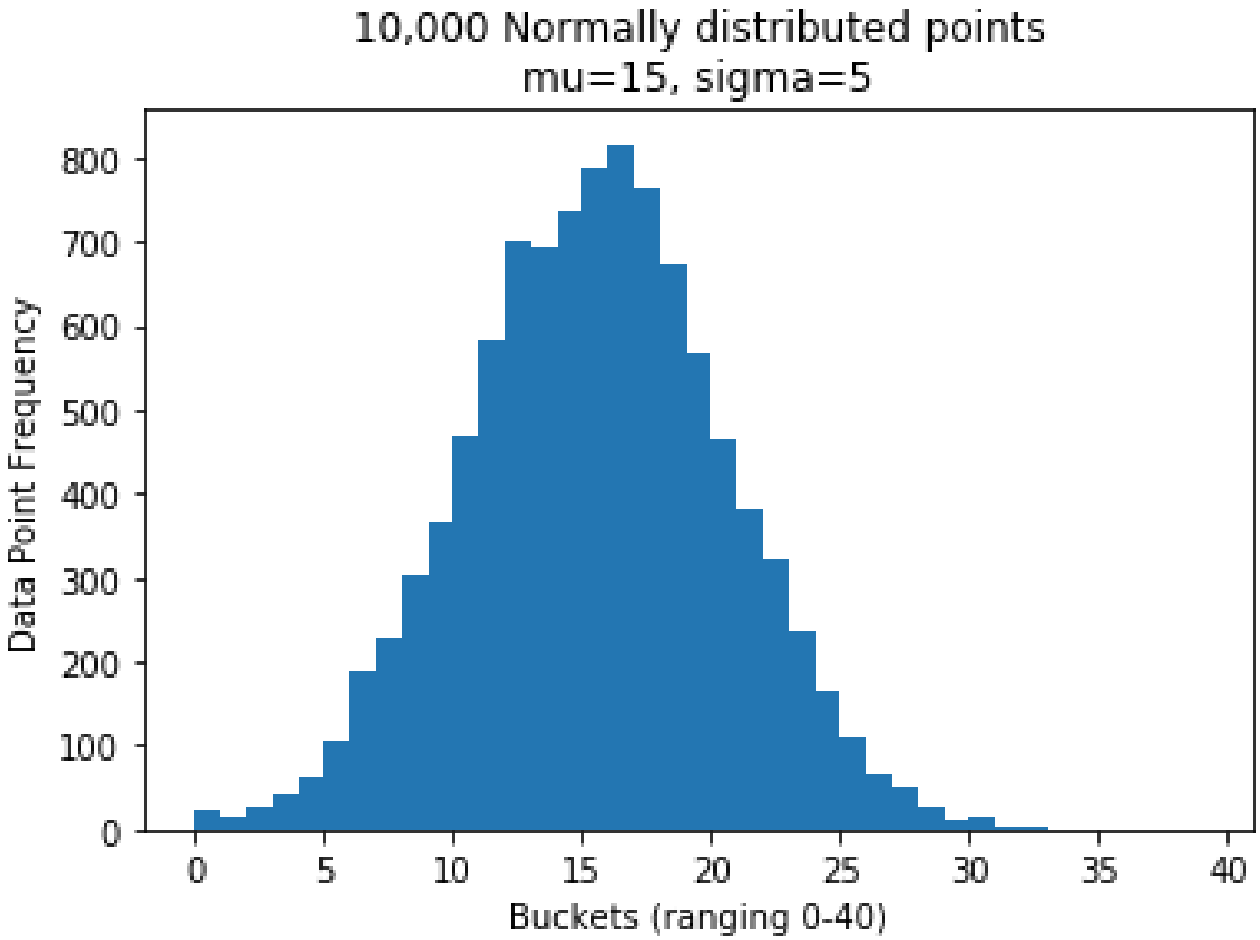
100 points


100 Normally distributed points
mu=15, sigma=5
Data Point Frequency
Buckets (ranging 0-40)
0
2
4
6
8
10
12
0
5
10
15
20
25
30
35
40

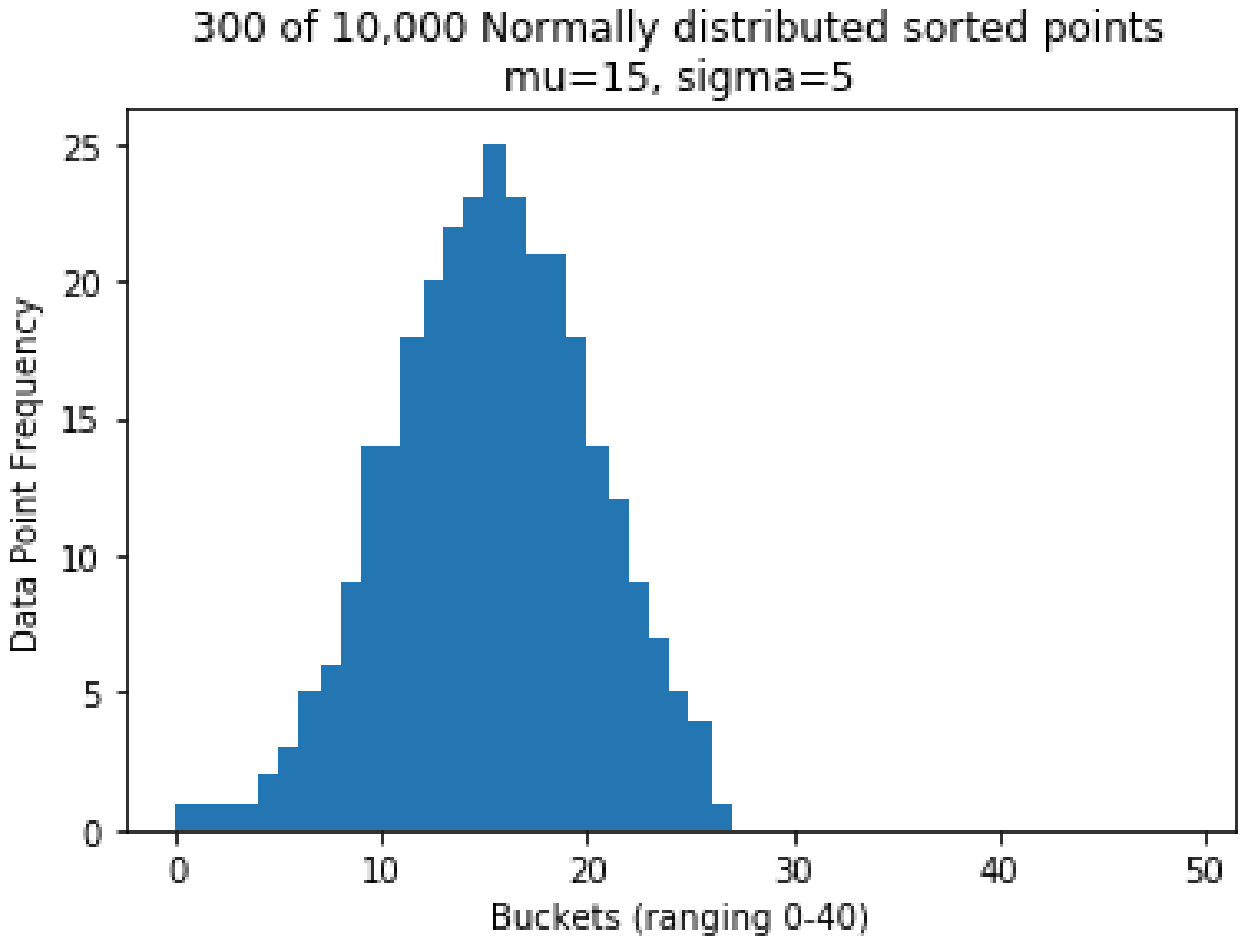
Law of Large Numbers

- Bernoulli's Principle
- Selection Scheme

10,000 points



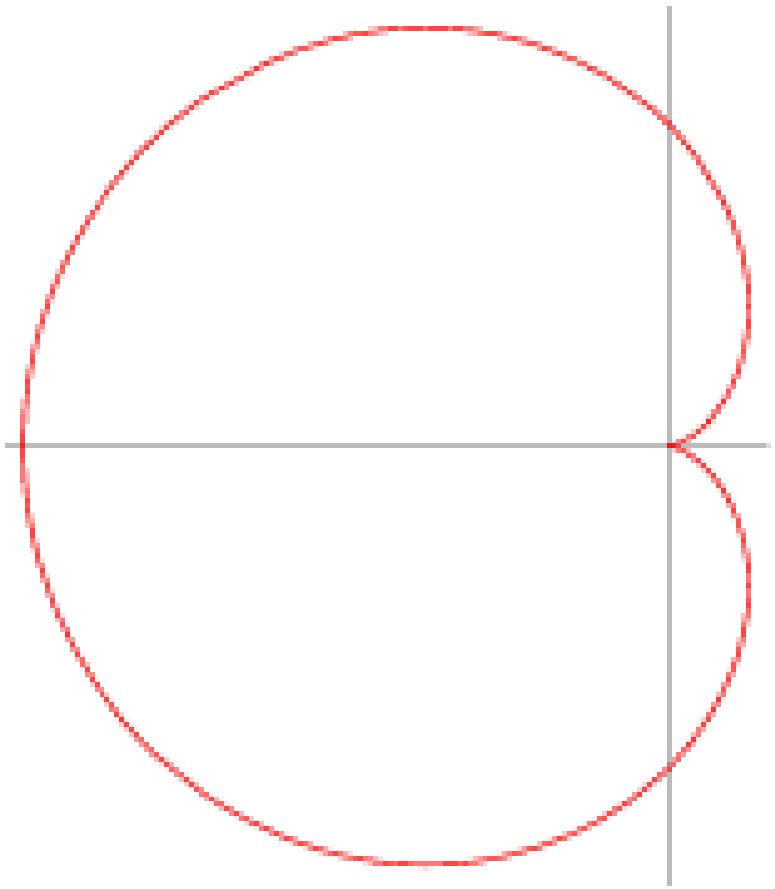
300 points


300 of 10,000 Normally distributed sorted points
mu=15, sigma=5
Data Point Frequency
0
5
10
15
20
25
0
10
20
30
40
50
Buckets (ranging 0-40)

Cardioids

Jamie L. Zimmerman

$$r = \alpha \pm \alpha cos\theta$$



Overview

Orbits Simulation

13-70-mass|right_slanted-position|right_slanted-velocity|uniform-diameter|left_slanted.csv

- Case 13
- 70 bodies
- Mass - right-slant
- Position - right-slant
- Velocity - uniform
- Diameter - left-slant

Starting Orbits

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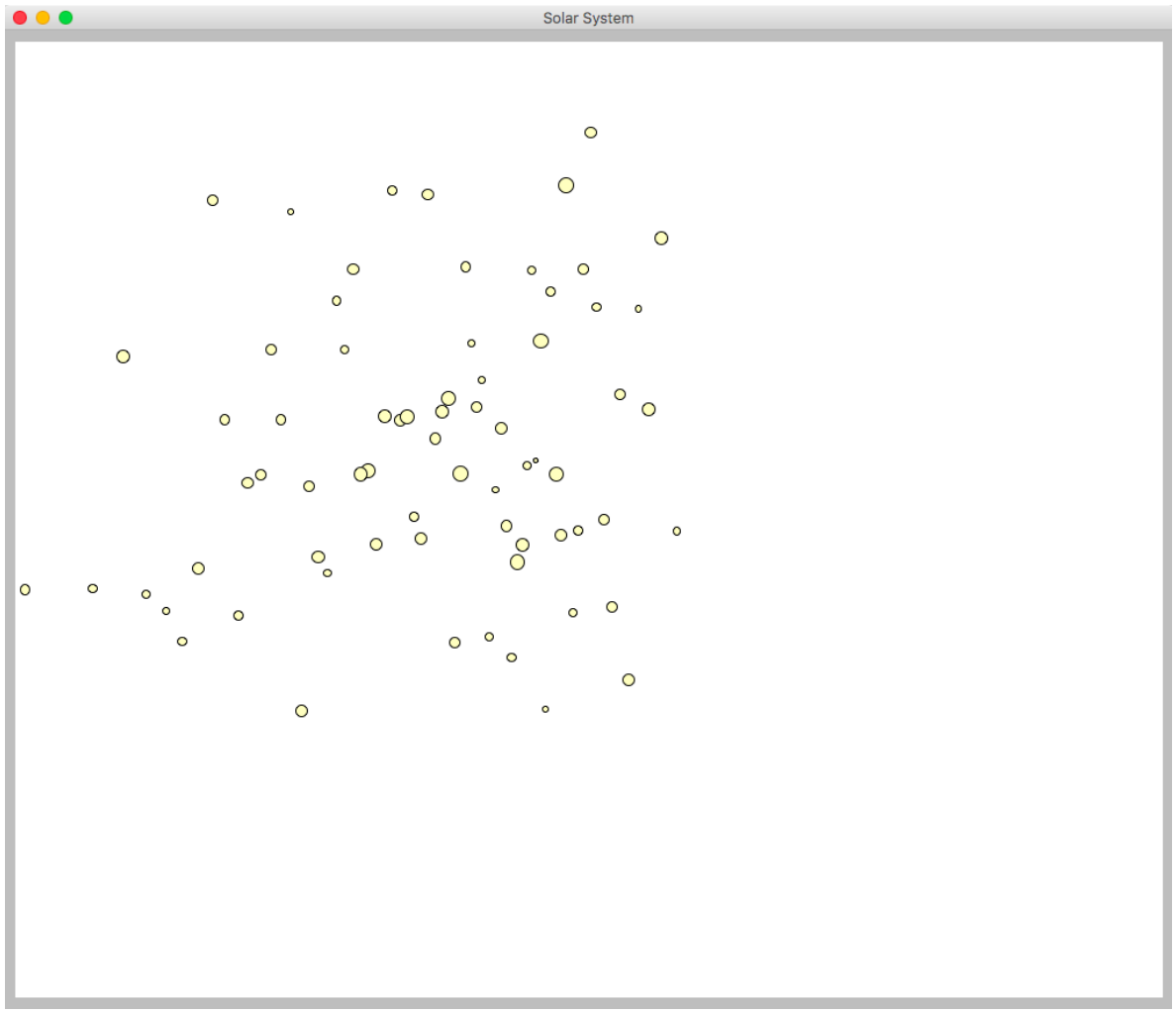


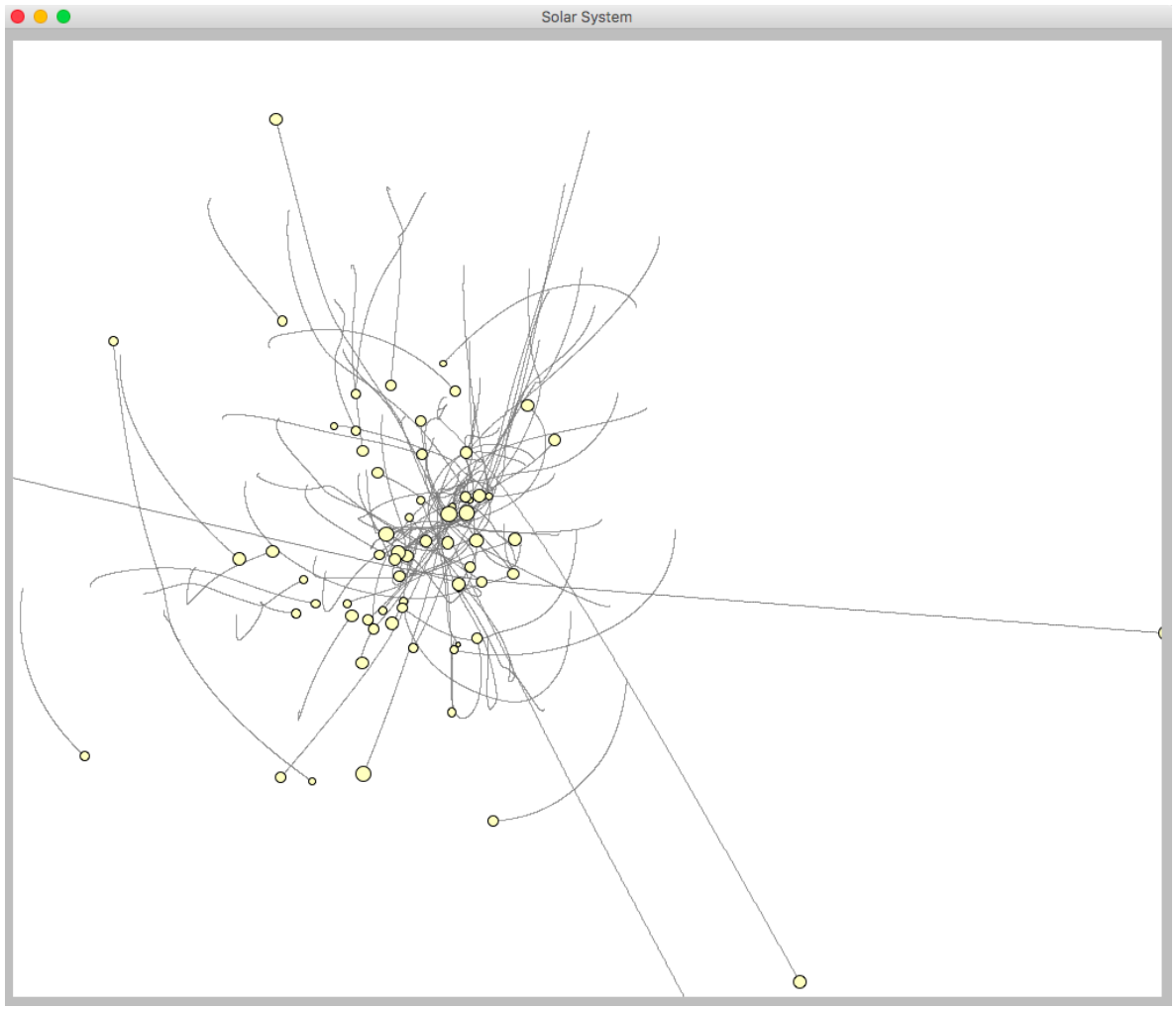
Starting Observations

- Sizes are mostly small-medium (from left-slant distribution)
- Locations are clustered (from right-slant distribution)

Ending Orbits

Jamie L. Zimmerman

665 time steps



Ending Observations

- Behavior of gravity
- Path lengths are all different (from uniform velocity)

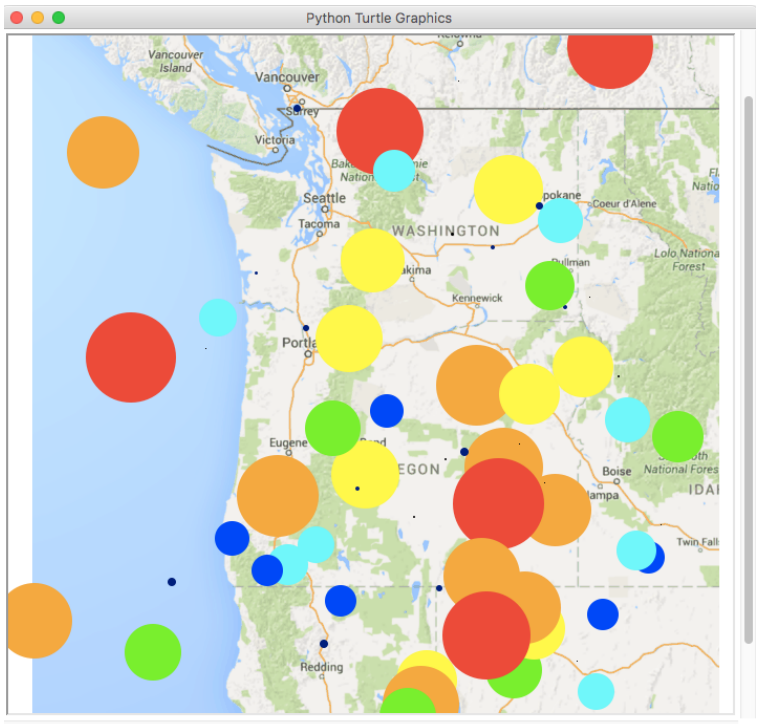
Earthquake Analysis

6-70-magnitudes|cardioid-latitudes|left_slanted-longitudes|right_slanted-depths|cardioid.csv

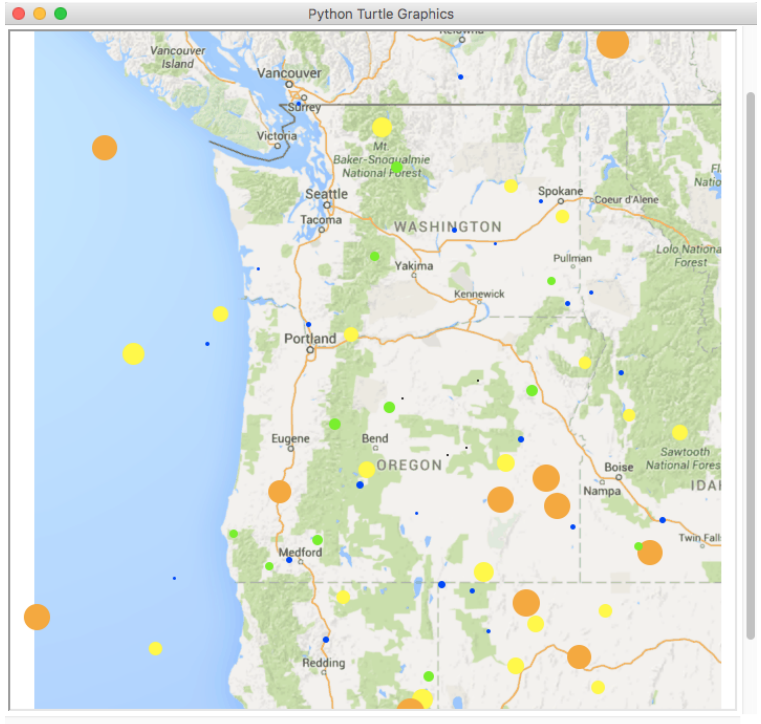
- Case 6
- 70 quake events
- Magnitude & Depth - Cardioid relationship
- Trend: High Magnitude $\rightarrow$ High Depth
- Low Magnitude $\rightarrow$ Low Depth
- Latitudes - left-slant
- Longitudes - right-slant

Magnitudes & Depths

Jamie L. Zimmerman



(a) Magnitudes



(b) Depths

Observations

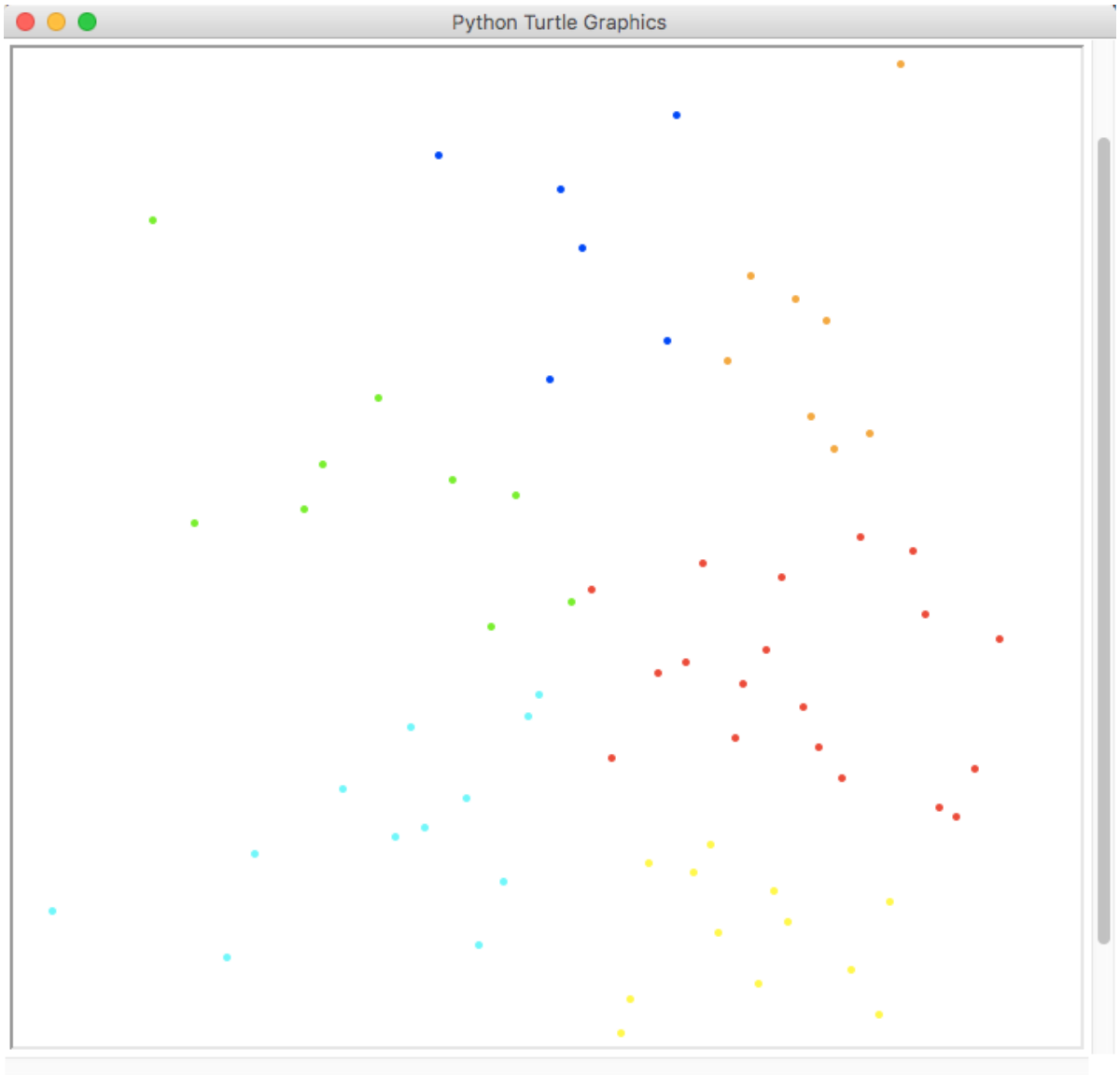
- Mostly predicted events?
- Any outliers?

Predict

- North - Up
- West - Left
- East - Right
- South - Down
- right-slanted is high numbers
- left-slanted is low numbers
- right-leaning longitudes
- left-leaning latitudes
- Quakes drift towards lower-right corner

Latitudes & Longitudes

Jamie L. Zimmerman



Overview

GenSequence in all its Power

- It is what it says it is
- Nearly end-to-end automation
- Knowing about input informs the expected output?

Future Work

- Test GenSequence against an open-source project
- Machine Learning Models
- Database-Driven Applications
- Combine user-written spec files