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Application of Sequence Alignment to Location Tracking Data

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Final Presentation

Introduction

- Location tracking data consist of a sequence of receivers which denotes the movement of a tag
- Problems
  - Doesn’t always pick up tag
  - May “lose” and “find” tag
  - May jump between receivers

Introduction

- Needle localization for breast biopsy patients may visit the same clinical area at different stages in the clinical process
- Location does not paint complete picture

Introduction

- Sequence alignment treats locations and stages in a clinical workflow like nucleotides
  - Accounts for noisy data
  - Accounts for deviation from clinical process
  - Helps detect type of patient and stage in clinical process

Methods

- Write sequence alignment program
  - PHP script
- Obtain location data
  - mySQL dump of raw data
  - Process via PHP scripts to clean data
- Create workflow templates

Results

ACC Check-In	Button1	2005-12-07 06:54:31
ACC Atrium Waiting	Change Location	2005-12-07 07:12:06
SDSU Changing Area	Change Location	2005-12-07 07:17:26
ACC Check-In	Change Location	2005-12-07 07:19:24
ACC Check-In	Tag Timeout	2005-12-07 07:20:15
Tea & Toast	New Location	2005-12-07 07:20:23
Hall Outside TRHA	Battery High	2005-12-07 07:20:24
Hall Outside TRHA	Inital Location	2005-12-07 07:20:34
TRHA 6-9	Change Location	2005-12-07 07:26:28
Hall Outside TRHA	Change Location	2005-12-07 07:28:24
SD Hall by RN Station	Change Location	2005-12-07 07:28:47
TRHA 6-9	Change Location	2005-12-07 07:29:29
TRHA 6-9	Tag Timeout	2005-12-07 07:30:30
SDSU Recovery 7-14	New Location	2005-12-07 07:30:38
SDSU Recovery 15-21	Battery High	2005-12-07 07:30:39
SDSU Nurses Station	Inital Location	2005-12-07 07:30:49

Results

Sub Waiting 1 Rm 260	Change Location	2005-12-07 09:24:38
Sub Waiting 1 Rm 260	Tag Timeout	2005-12-07 09:31:49
Exam Rms 263A-D	New Location	2005-12-07 09:32:18
Exam Rms 263A-D	Inital Location	2005-12-07 09:32:29
Exam Rms 263A-D	Battery High	2005-12-07 09:32:38
Exam Rms 263A-D	Tag Timeout	2005-12-07 09:55:03
Exam Rms 263A-D	New Location	2005-12-07 09:56:37
Exam Rms 263A-D	Inital Location	2005-12-07 09:56:48
Exam Rms 263A-D	Battery High	2005-12-07 09:57:22
Exam Rms 263A-D	Tag Timeout	2005-12-07 10:02:23
Exam Rms 263A-D	New Location	2005-12-07 10:03:31
Exam Rms 263A-D	Inital Location	2005-12-07 10:03:43
Exam Rms 263A-D	Battery High	2005-12-07 10:04:47
Exam Rms 263A-D	Tag Timeout	2005-12-07 10:09:44
Exam Rms 263A-D	New Location	2005-12-07 10:09:57
Exam Rms 263A-D	Inital Location	2005-12-07 10:10:08
Exam Rms 263A-D	Battery High	2005-12-07 10:10:11

Results

Sub Waiting 1 Rm 260	New Location	2005-12-07 09:24:07
Sub Waiting 1 Rm 260	Change Location	2005-12-07 09:24:38
Exam Rms 263A-D	New Location	2005-12-07 09:32:18
Exam Rms 286/288	New Location	2005-12-07 10:51:53
Exam Rms 263A-D	New Location	2005-12-07 10:54:27

Results

- Take data and make an array of locations in order
  - $data=array('chk', 'wt', 'chng', 'chk', 'tt', 'trha', 'htrha', 'rnst', 'trha', 'sdsur', 'sdsur', 'sdsun', 'sdsur', 'sdsun', 'sdsur', 'rwt', 'rwt', 'exam', 'exam', 'exam', 'hall', 'trha', 'htrha', 'trha', 'tt', 'tr', 'htrha', 'sdsur', 'sdsun');

Results

- Create workflow template from theoretical workflow or location tracking data
- Sample clinical workflow
  - $template=array('chk', 'wt', 'chng', 'sdsur', 'hall', 'exam', 'hall', 'trha', 'tr', 'sdsur');

Results

		chk	wt	chng	chk	tt	trha	htrha	rnst	trha	sdsur	sdsur	sdsun	sdsur	sdsun	sdsur	rwt	rwt	exam	exam	exam	hall	trha	htrha	trha	tt	tr	htrha	sdsur	sdsun
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
chk	1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
wt	2	1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
chng	3	2	1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
sdsur	4	3	2	1	1	2	3	4	5	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
hall	5	4	3	2	2	2	3	4	5	6	7	7	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	24
exam	6	5	4	3	3	3	3	4	5	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	19	20	21	22	23	24
hall	7	6	5	4	4	4	4	4	5	6	7	8	9	9	10	11	12	13	14	14	15	15	16	17	18	19	20	21	22	23
trha	8	7	6	5	5	5	4	5	5	5	6	7	8	9	10	11	12	13	14	15	15	16	15	16	17	18	19	20	21	22
tr	9	8	7	6	6	6	5	5	6	6	6	7	8	9	10	11	12	13	14	15	16	16	16	16	17	18	18	19	20	21
sdsur	10	9	8	7	7	7	6	6	6	7	6	6	7	8	9	10	11	12	13	14	15	16	17	17	17	18	19	19	19	20

Results

0	0	0	0	1	2	3	4	5	6	6	7	8	9	10	11	12	13	13	14	15	15	15	16	17	18	18	19	19	20
	chk	wt	chng	chk	tt	trha	htrha	rnst	trha	sdsur	sdsur	sdsun	sdsur	sdsun	sdsur	rwt	rwt	exam	exam	exam	hall	trha	htrha	trha	tt	tr	htrha	sdsur	sdsun
	chk	wt	chng	-	-	-	-	-	-	sdsur	-	-	-	-	-	-	hall	exam	-	-	hall	trha	-	-	-	tr	-	sdsur	-

Results

- Can we determine the stage in the clinical process?
- Let’s take part of the process as:
  - $data=array('chk', 'wt', 'chng', 'chk', 'tt', 'trha', 'htrha', 'rnst', 'trha', 'sdsur', 'sdsur');

Results

- Then look at the scores as we step through the template:
  - ('chk') = 20
  - ('chk', 'wt') = 18
  - ('chk', 'wt', 'chng‘) = 16
  - ('chk', 'wt', 'chng', 'sdsur') = 14
  - ('chk', 'wt', 'chng', 'sdsur', 'hall') = 15
  - ('chk', 'wt', 'chng', 'sdsur', 'hall', 'exam') = 17
  - ('chk', 'wt', 'chng', 'sdsur', 'hall', 'exam', 'hall') = 19
  - ('chk', 'wt', 'chng', 'sdsur', 'hall', 'exam', 'hall', 'trha') = 18
  - ('chk', 'wt', 'chng', 'sdsur', 'hall', 'exam', 'hall', 'trha', 'tr') = 19
  - ('chk', 'wt', 'chng', 'sdsur', 'hall', 'exam', 'hall', 'trha', 'tr', 'sdsur') = 17

Results

- Data feed
  - $data=array('chk', 'wt', 'chng', 'chk', 'tt', 'trha', 'htrha', 'rnst', 'trha', 'sdsur', 'sdsur');
- Template section
  - ('chk', 'wt', 'chng', 'sdsur') = 14

Discussion

- Location data can be matched to clinical process templates via sequence alignment
- Can be used to determine location in clinical process
- With additional templates, can be used to predict type of patient or detect process exceptions

Questions?