

CPTV - Generating Personalized TV Schedules

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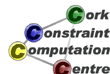


Ireland's EU Structural Funds
Programmes 2007 - 2013

Co-funded by the Irish Government
and the European Union

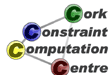


Ciste Forbairtíochta Réigiúnal na hEirípa



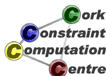
Outline

- 1 Motivation
- 2 Overview
- 3 Scheduler
- 4 Conclusions



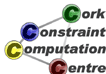
Typical Applications of Constraint Programming

- Industrial Scheduling
- Configuration
- Personnel Planning
- Transport
- Network Optimization



Personal CP Applications

- Not a lot of applications for individual use
- People don't have NP-hard problems?
- Some advisors, recommenders based on CP
 - ECRC: The Munich Rent Advisor, (Fruewirth et al, 1994)
 - 4C: Talking Shop (Little et al, 2008)
- Sudoku?



Important: Proof of Concept

- This is not about the model
- This is not about the constraint engine
- This is about the application
- Funded to show how such a system would work
- Explore functionality, data feeds, etc
- No beautiful interfaces, just get it to work



Some Facts about TV

- In Ireland, 75% of households have satellite or cable (Source: Comreg, 2009)
- Easy to get 200+ channels
- Average TV viewing time
 - US, per household, in 2008: 8 Hr. 21 Min/day, (Source: Nielsen, 2009)
 - UK, per person: 28 Hr/week (van den Broek, 2002)
- 95% of TIVO TV watching is live, not recorded or time-shifted (Bronnenberg et al, 2010)
- UK Total TV market 10B£ (Source: Ofcom, 2006)



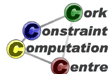
A Requirement for Personalized TV

- 200 channels, and I don't know what to watch!
- Record & watch is not the defining paradigm
 - Some programs you have to watch live (sports)
 - Others you can time-shift within a day (news)
 - Others you can watch anytime (movies)
 - Some programs you have to watch in sequence, others not
- DVR is not an infinite resource
- Don't record what you won't watch
- There is a life beyond TV



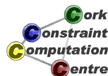
TV Calendar

10:00			Meeting with TI				
11:00		Peter Norvik meetings: Tech transfer 4C					
12:00			SFI webinar 4C				
13:00							
14:00		Peter Norvik meeting: Ideas pitch		seminar committee			
15:00			Energy research institute discussion				
16:00						The Simpsons: Monk Catherine's Italian Kit	The Mentalist: Bloodshot Hallmark Channel
17:00		Q&A Peter Norvik				Psycho Sky Movies Sci-Fi/Horror	The Simpsons: Selma Who Do You Think You Are?: Alistair Watch
18:00							The Big Bang Theory:
19:00	The Day the Earth Stood Still Sky Movies Classics	Time Team: Normanton Discovery Channel -1	Battlestar Galactica: Litmus Sky2	In the Heat of the Night Sky Movies Classics	Veronica Mars: Wichita Linebacker E4	Kim Posi Megastru Super National	Point Blank TCM
20:00	Monk: Mr Monk Falls in Love Hallmark Channel -1	cork camera group Boole Lecture G4	Doctor Who: The Doctor Dances Watch -1	The Big Bang Theory:	Doctor Who: Bad Wolf Watch -1	The Mentalist: A Dozen Red Roses Hallmark Channel -1	Battlestar Galactica: Hand of God Sky2
21:00	The Big Bang Theory:		The Big Bang Theory:	Time Team: Rycote Discovery Channel +1	The Big Bang Theory:	Come West Along Th	Doctor Who BBC Two Generic
22:00	BBC News at Ten; BE		BBC News at Ten; BE	Bones: The Goop on the Girl Sky1 HD	BBC News at Ten; BE	The Big Bang Theory:	Time Team: No Stone Unturned more4
23:00		The Big Bang Theory:		BBC News at Ten; BE			



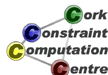
Existing Work

- 1995-2002: Many papers on TV recommenders
- Mainly collaborative recommenders
- Quite limited acceptance
- No concept of time/scheduling



Current Solutions

- Nearly always grid based (just like printed program guides)
- This works for 4 channels, not for 200
- Even more so when running on a mobile phone
- Settop boxes:
 - Record complete series
 - Program from mobile
 - LRU replacement strategy



Typical Grid View

Grid - Windows Internet Explorer

https://localhost:8080/grid.htm

File Edit View Favorites Tools Help

Grid

Home Channel Package Channel List Grid Boxsets DVDs History Rules Selected Import TV Time Scheduler Recording Watch

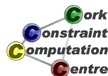
monday, 9/11 12:00 - 18:00

Channel	12:00	13:00	14:00	15:00	16:00
Alibi	Diagnosis Murder: 35 Millimetre Murder	Murder, She Wrote: If the Frame Fits	Diagnosis Murder: The Murder Trade	Bergerac: The Sins of the Fathers	Diagnosis Murder: 35 Millimetre Murder
Alibi +1	Murdoch Mysteries: The Annoying Red...	Diagnosis Murder: 35 Millimetre Murder	Murder, She Wrote: If the Frame Fits	Diagnosis Murder: The Murder Trade	Bergerac: The Sins of the Fathers
At The Races	The Monday Review	Racing Live			
88C One Generic	Car Bo... Bargain Hunt: Grimshorpe	88C News at One Region... Doctors: Robbed	Murder, She Wrote: Mour...	B... Mister Maker Uncl... Eliot Kl... Oogles	School of Silence M.I.
88C Two Generic	The Daily Politics Working Lunch	All Saints: In Control	Open House	Crisis Claims and Cons: Dia...	Diagnosis Murder: Murder b... Flog 21: Weston
Boomerang	Tom and Jerry	Bugs and Daffy	Tom and Jerry Ta... The Scooby-Doo...	Garfield	Looney Tunes Tom and Jerry Casper's Scare Sc... Garfield
Boomerang +1	Shaggy and Scoo... Garfield	Tom and Jerry Scooby-Doo, Who... Bugs and Daffy	Tom and Jerry Ta... The Scooby-Doo...	Garfield	Looney Tunes Tom and Jerry Casper's Scare Sc... Garfield
Bravo	Dog the Bounty H... Dog the Bounty H...	Martial Law: 24 Hours	Frontline Crime 999	Frontline Crime 999	Chuck Knight Rider: Knight by a No...
Bravo +1	Most Shocking Under the Influence	Dog the Bounty H... Dog the Bounty H...	Martial Law: 24 Hours	Frontline Crime 999	Frontline Crime 999
Bravo 2	World's Most Amazing Videos	Monster Jam	Monster Jam	Street Crime UK	Street Crime UK When Sport Goes Bad World's Most Amazing Video
British Eurosport	FFA Under-17 World Cup				Live FFA Under-17 World Cup
British Eurosport 2	Eurosport2 News				
CHBC	US CHBC Squawk Box				
Cartoon Network	Chop Socky Chooks				
Cartoon Network Too	Codename: Kids Next Door				
Challenge	Bruce Forsyth's Pl...				
Challenge +1	Wipeout				
Channel 4	News at Noon	Pro... The Money P...			
Comedy Central	Scrubs: My Best F... Scrubs: My Coffee	Frasier: Mixed Do... Frasier: Head Game	The King of Quee...	The King of Quee... Two and a Half M... Two and a Half M...	Scrubs: My Best F... Scrubs: My Coffee
Comedy Central +1	The King of Quee... The King of Quee...	Scrubs: My Best F... Scrubs: My Coffee	Frasier: Mixed Do... Frasier: Head Game	The King of Quee... The King of Quee...	Two and a Half M... Two and a Half M...
Comedy Central Extra	Everybody Loves... Everybody Loves...	3rd Rock from the... 3rd Rock from the...	Everybody Loves... Everybody Loves...	3rd Rock from the... 3rd Rock from the...	Rules of Engagem... MASH: Hepatitis MASH: The Gener... The King of Quee...
Comedy Central Extra	Frasier: Mixed Do... Frasier: Head Game	Everybody Loves... Everybody Loves...	3rd Rock from the... 3rd Rock from the...	Rules of Engagem... Rules of Engagem...	MASH: Hepatitis MASH: Hepatitis MASH: The Gener... The King of Quee...
Dave	Top Gear	Top Gear	Fifth Gear	Traffic Cops: Wea... Stephen Fry in America: New World Top Gear	Top Gear
Dave 3s vu	Stephen Fry in America: New World	Top Gear	Top Gear	Fifth Gear	Traffic Cops: Wea... Stephen Fry in America: New World
Discovery Home and...	Brat Camp II	10 Years Younger	Little People, Big... Little People, Big...	Brat Camp II	Brat Camp II
Discovery Home and...	Jon and Kate Plus... Jon and Kate Plus...	Brat Camp II	10 Years Younger	Little People, Big... Little People, Big...	Brat Camp II
Discovery Real Time	A Place by the Sea: Poole Bay	Selling Houses Abroad	House Doctor	House Doctor	Tommy Walsh's E... Tommy Walsh's E...
Discovery Real Time...	Come Dine with Me	Come Dine with Me	A Place by the Sea: Poole Bay	Selling Houses Abroad	House Doctor
Discovery Shed	Smith and Sweet... Smith and Sweet...	Holmes on Homes	A Passion for Angling	Go Fishing	Go Fishing
Discovery Travel and...	Superhomes: Pas... Superhomes: Roo...	A Place in the Sun... A Place in the Sun...	The Perfect Home	House Doctor	House Doctor
Discovery Travel and...	No Going Back: A... No Going Back: A...	Superhomes: Pas... Superhomes: Roo...	A Place in the Sun... A Place in the Sun...	The Perfect Home	House Doctor



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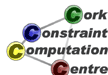
In the Beginning - Data

- What can we do with existing/accessible data
- Not what data would we like
- Small project, limited resources
- Most data is in wrong/unstructured format
- We can't afford to enter data by hand
- We initially don't have large user base to provide data for us



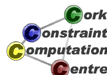
Data Sources

- XMLTV - TV Program data
- Lots of information about shows and movies
 - Wikipedia
 - IMDB, Rotten Tomatoes, Metacritic: Movie reviews
 - Epguide: Episode names, sequence
 - TVTropes: Deep content based discussion of TV, movies, anime, comics
- Personal Calendars: iCal
- Providers: Channel lists and packages

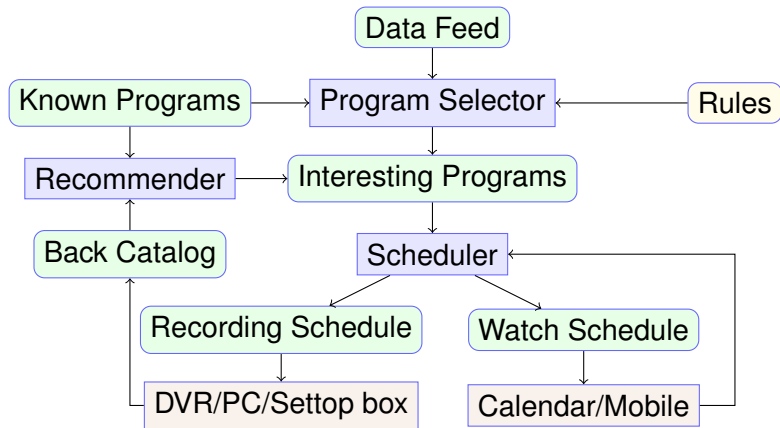


XMLTV format

```
<programme start="20091128220000 +0000" stop="20091129000000 +0000"  
    channel="zonethriller.tv">  
    <title>Don't Look Back</title>  
    <desc lang="en">Bleak drama about an alcoholic drug addict who hopes  
his fortunes have changed when he finds a stash of money. But it transpires  
that the cash belongs to the Mob, and the man is forced into hiding in his  
hometown where his friends are drawn into his dilemma.</desc>  
    <credits>  
        <director>Geoff Murphy</director>  
        <actor>Eric Stoltz</actor>  
        <actor>John Corbett</actor>  
        <actor>Josh Hamilton</actor>  
        <actor>Annabeth Gish</actor>  
        <actor>Billy Bob Thornton</actor>  
        <actor>Dwight Yoakam</actor>  
    </credits>  
    <date>1996</date>  
    <category lang="en">Film</category>  
</programme>
```



Architecture



Program Selector

- Rule based program selection
- Rules entered by user
- Rules entered manually or defined by similarity
- Attributes/Relations
 - Title, category, cast, season/year, channel, keyword, time
 - is, in, not in, contains, before, after
- Prolog search engine



Rule Example

Add Rule - Windows Internet Explorer
http://localhost:8080/cgi-bin/add_rule_title_category.pl?category=Drama&title=Battlestar Galactica

File Edit View Favorites Tools Help
Convert Select

Home Channel Package Channel List Categories Films Directors Grid Boxsets DVDs History Rules Selected Import TV Time Scheduler Recording Watch

Properties

Name:

Priority:

Attributes

Title:

Sub Title:

Channel:

Start Time:

Category:

Director:

Actor:

Star Rating:

Keyword:

Constraints

Per Day:

Per 2 Days:

Per Week:

Time Shift:

Place Shift:

Mood:

Set of Rules for User

Rule Editor - Windows Internet Explorer

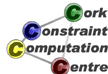
https://localhost:8080/cgi-bin/rule_editor.sh

File Edit View Favorites Tools Help

Home Channel Package Channel List Categories Films Directors Grid Boxsets DVDs History Rules Selected Import TV Time Scheduler Recording Watch

Add Edit Delete Test Fix Selection

Enabled	Title	Priority	Per Day	Per 2 Days	Per Week	Time	Place	Mood	Condition(s)
<input type="checkbox"/>	Bones	Very Keen	0 - 1	0 - 1	0 - 5	no	yes	any	title is Bones
<input type="checkbox"/>	BBC News	Must Watch	0 - 1	0 - 10	0 - 5	shift	yes	any	title starts_with BBC News, start is 2200
<input type="checkbox"/>	Celtic Connections	Quite Keen	0 - 1	0 - 2	0 - 5	yes	yes	any	title is Celtic Connections
<input type="checkbox"/>	Fleadh Cheoil	Quite Keen	0 - 1	0 - 2	0 - 5	yes	yes	any	title is Fleadh Cheoil
<input type="checkbox"/>	Battlestar Galactica	Very Keen	0 - 1	0 - 2	0 - 5	yes	yes	any	title is Battlestar Galactica
<input type="checkbox"/>	Joan of Arcadia	Quite Keen	0 - 1	0 - 1	0 - 2	yes	yes	any	title is Joan of Arcadia
<input type="checkbox"/>	Monk	Very Keen	0 - 1	0 - 2	0 - 5	yes	yes	any	title is Monk
<input type="checkbox"/>	Foyle's War	Quite Keen	0 - 1	0 - 2	0 - 5	yes	yes	any	title is Foyle's War
<input type="checkbox"/>	Megastructures	Keen	0 - 1	0 - 1	0 - 2	yes	yes	any	title is Megastructures
<input type="checkbox"/>	Coronation Street	Interested	0 - 1	0 - 2	0 - 5	yes	yes	any	title is Coronation Street
<input type="checkbox"/>	Doctor Who	Very Keen	0 - 1	0 - 1	0 - 3	yes	yes	any	title is Doctor Who
<input type="checkbox"/>	The Simpsons	Interested	0 - 1	0 - 2	0 - 5	yes	yes	any	title is The Simpsons
<input type="checkbox"/>	QI	Very Keen	0 - 1	0 - 2	0 - 5	yes	yes	any	title is QI channel in [BBC2, BBC4]
<input type="checkbox"/>	Russian Revolution	Very Keen	0 - 1	0 - 2	0 - 5	yes	yes	any	category in [Documentary], keyword in [History, Russia, Revolution, Lenin, Stalin, Soviet]
<input type="checkbox"/>	Titanic	Very Keen	0 - 1	0 - 2	0 - 5	yes	yes	any	keyword in [Titanic]
<input type="checkbox"/>	Wind Energy	Very Keen	0 - 1	0 - 2	0 - 5	yes	yes	any	keyword in [Wind Energy, Wind Turbine, Alternative Energy]
<input type="checkbox"/>	Classical Music	Quite Keen	0 - 1	0 - 2	0 - 5	yes	yes	any	category is Music and Arts, keyword in [Classical Music, Bach, Beethoven, Mozart, Hoende]
<input type="checkbox"/>	Champions League	Must Watch	0 - 1	0 - 2	0 - 5	no	yes	Sport	title contains Champions League Live
<input type="checkbox"/>	Time Team	Quite Keen	0 - 1	0 - 1	0 - 2	yes	yes	any	title contains Time Team
<input type="checkbox"/>	John Ford	Must Watch	0 - 1	0 - 2	0 - 5	yes	no	any	director is John Ford
<input type="checkbox"/>	Howard Hawks	Must Watch	0 - 1	0 - 2	0 - 5	yes	no	any	director is Howard Hawks
<input type="checkbox"/>	Kate Beckinsale	Very Keen	0 - 1	0 - 2	0 - 5	yes	no	any	actor is Kate Beckinsale
<input type="checkbox"/>	****	Quite Keen	0 - 1	0 - 2	0 - 5	yes	no	any	star_rating is 5/5
<input type="checkbox"/>	****	Keen	0 - 1	0 - 2	0 - 5	yes	no	any	star_rating is 4/5
<input type="checkbox"/>	The Mentalist	Very Keen	0 - 1	0 - 2	0 - 5	yes	yes	any	title is The Mentalist



Result: Interesting Programs

Selected - Windows Internet Explorer

http://localhost:8080/cgi-bin/rule_editor_action.php?action=fix+Selection

File Edit View Favorites Tools Help

Home Channel Package Channel List Categories Films Directors Grid Boxsets DVDs History Rules Selected Import TV Time Scheduler Recording Watch

Selected (1267 entries)

Day	Start	End	Scheduled	Title	Year	Category	Status	Channel	Value	Why
Sun 15/11	22:00	22:20	--/-- --:--	BBC News	-	News and Current Affairs	new	BBC One Generic	5000	BBC News
Sun 22/11	22:00	22:20	--/-- --:--	BBC News	-	News and Current Affairs	new	BBC One Generic	5000	BBC News
Fri 20/11	22:00	22:25	--/-- --:--	BBC News at Ten	-	News and Current Affairs	new	BBC One Generic	5000	BBC News
Fri 27/11	22:00	22:25	--/-- --:--	BBC News at Ten	-	News and Current Affairs	new	BBC One Generic	5000	BBC News
Mon 23/11	22:00	22:25	--/-- --:--	BBC News at Ten	-	News and Current Affairs	new	BBC One Generic	5000	BBC News
Wed 25/11	22:00	22:25	--/-- --:--	BBC News at Ten	-	News and Current Affairs	new	BBC One Generic	5000	BBC News
Tue 24/11	22:00	22:25	--/-- --:--	BBC News at Ten	-	News and Current Affairs	new	BBC One Generic	5000	BBC News
Tue 17/11	22:00	22:25	--/-- --:--	BBC News at Ten	-	News and Current Affairs	new	BBC One Generic	5000	BBC News
Thu 26/11	22:00	22:25	--/-- --:--	BBC News at Ten	-	News and Current Affairs	new	BBC One Generic	5000	BBC News
Mon 16/11	22:00	22:25	--/-- --:--	BBC News at Ten	-	News and Current Affairs	new	BBC One Generic	5000	BBC News
Thu 19/11	22:00	22:25	--/-- --:--	BBC News at Ten	-	News and Current Affairs	new	BBC One Generic	5000	BBC News
Wed 18/11	22:00	22:25	--/-- --:--	BBC News at Ten	-	News and Current Affairs	new	BBC One Generic	5000	BBC News
Wed 25/11	19:00	22:50	--/-- --:--	Champions League Live	-	Sport	new	RTE TWO	5000	Champions League
Sun 15/11	14:20	16:10	--/-- --:--	Battlestar Galactica	-	Drama	dvd	Sci Fi +1	1000	Battlestar Galactica
	15:10	17:00	--/-- --:--	Battlestar Galactica	-	Drama	dvd	Sci Fi	1000	Battlestar Galactica
				Battlestar						Battlestar



Recommender

- Two different systems
 - One for movies
 - The other for TV shows
- Both are content based recommenders
- No start-up problem
- Lots of content description available



Recommender Systems

- Collaborative
 - Users, who are similar to you, also like this
 - Requires large user base to be meaningful
 - Works well with positive and negative examples
- Content based
 - These items share characteristics with the items you like
 - Requires “mineable” description of content
 - Categories, tags and keywords can be useful



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Constraints

- You can only watch one program at a time
- Depending on your tuner, you can not record more than n programs at a time
- We assume that you watch programs completely
- From the description and rules we know which programs must we watched
 - Live
 - Time shifted on same day
 - Can be watched anytime
- If programs are repeated, you should only watch them once



Viewing Preferences

- Programs are classified by the rules
- Based on categories, not numerical values
 - Must watch
 - Very keen
 - Quite keen
 - Keen
 - Interested
 - Not interested
- Try to maximize each category in turn



Best Quality?

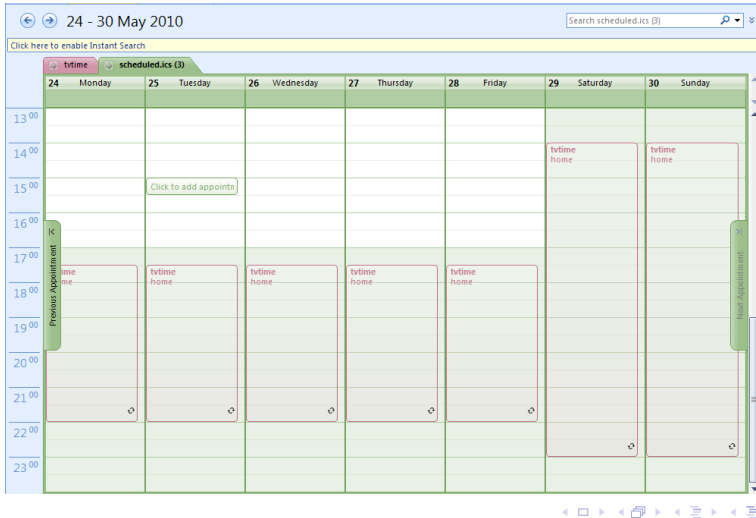
- HD/SD quality
- Surround sound
- Some channels have few/many ad breaks, others none
- Some information in XMLTV data
- Look at program duration
- Display device available

More Constraints

- You can only watch TV in your “TV time windows” (based on calendar availability rules)
- If you have another event in the calendar, then don’t schedule TV for that time
- If you are away from home, then you may/may not be able to watch TV
- You may not want to watch movies remotely on a mobile phone, but perhaps your home sport news



Viewing Windows



Even More Constraints

- There may be limits on how many programs of the same show you want to watch
- “The Simpsons” marathon, anyone?
- There may be limits on how many shows of a particular category you want to watch on a day
 - on two consecutive days
 - within a week



Final Constraints

- Some series must be watched in sequence, others don't need to
- This rarely matters for repeated shows
- If you start a series, then you want to watch all episodes, or none
 - Don't skip every second episode of "Lost"
- For some series, only schedule the current season (new programs)



- You can stream some shows from the Internet, without recording
- If this is legal (e.g. BBC Player), there are constraints on the time window
- Program will be available after first transmission, and then for 7, 14, 28 days

Family Constraints

- Are you fighting for the remote all the time?
- Many resource constraints due to multiple viewers
- Not handled so far

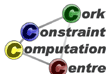


Modelling this problem with Constraints

- Finite domain model
- MIP model for live TV only
- Hybrid MIP/FD

Finite Domain Constraint Programming

- Problems are expressed by variables and constraints
- Variables range over possible domain
- Constraints restrict feasible values for variables
- Many different types of constraints are known
- Propagation removes values which can not be in solution
- Coupled with search to find solution



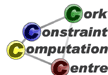
Finite Domain Model

- Each selected program is a potential task
- Tasks must be scheduled on resources
 - Disjunctive resources (TV)
 - Cumulative resources (DVR)
 - Alternative resources (DVR/PC)
- Viewing windows handled by
 - dummy tasks
 - calendar constraint
- Producer/Consumer constraints for storage
- Lots of temporal constraints



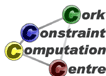
Search

- Incomplete search
 - Credit based search
 - With time limit
- Heuristic: Try to schedule valuable programs first



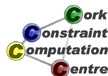
Problems with Model

- Most selected programs can not be scheduled
- This is modelled with
 - Dummy value
 - Very large horizon, cut off after two weeks
- Good reasoning requires special versions of resource constraints



What about Cost?

- We don't want just any solution
- Solution should “maximize” our enjoyment
- Maximize an objective function?
- Sum of values for each scheduled program
- Very weak reasoning on this cost



Alternative: Solve a simpler problem

- Consider you can not record programs
- All programs must be watched live
- Can be modelled with MIP

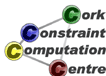
MIP Model for Restricted Problem

- For each selected program define a 0/1 variable
- x_i decides if program i is scheduled or not
- If program is scheduled, its time is fixed



Constraints in MIP Model

- Watch only one program at a time
 - $\forall t: \sum_{i \text{ overlaps } t} x_i \leq 1$
- Don't watch repeated programs twice
 - $\forall p: \sum_{i \text{ repeats } p} x_i \leq 1$
- Only k movies on a day/in a week

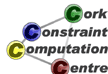


Maximizing Enjoyment

- Objective Function
- $\max \sum_i w_i x_i$
- Handled very well by MIP solver

Problems with MIP Model

- Some temporal constraint are tedious (minor)
- Very hard to extend to record&watch
- Variables x_{it} program i is watched at time t
- Too many time points, model explodes



Solution: Hybrid Model

- Combine the best features of both approaches
- Avoid weaknesses by exploiting strength of methods
- First Step: Allocation to time periods
- Second Step: Detailed sequencing



Step 1: Allocation to Time Periods

- MIP Model
- 0/1 variable x_{ip} tells if program i is scheduled in period p
- Increases number of variables only by small factor (14 days horizon)
- Keep objective function
- Handle capacity of each period by multiple knapsack constraints
 - $\forall p: \sum_i d_i x_{ip} \leq c_p$
- Capacity expressed as time, but also possible for categories, etc
- Use rounding of coefficients to decrease complexity
- Don't fix recording schedule, but post redundant constraint



Step 2: Detailed Sequencing

- Finite domains
- Only model scheduled programs, huge reduction in variables
- Recording constraints given by choosing between fixed transmission times
- Temporal constraints between recording and watching tasks
- Usual resource constraints
- Allow relaxation of time window end to avoid infeasible second phase



Schedule in Google Calendar



Variant: Suggest alternatives

- Allow two programs to be watched at any time
- Give user more flexibility
- Only requires capacity change in both models

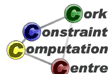
Alternative Suggestions

The screenshot shows a Microsoft Outlook calendar window titled "Calendar - Microsoft Outlook". The interface includes a menu bar (File, Edit, View, Tools, Actions, Help, Adobe PDF), a toolbar, and a search bar. The main view is a weekly calendar for the period "23 - 29 November 2009".

On the left side, there is a "Calendar" sidebar with a monthly view for November and December 2009. Below this, there are sections for "All Calendar Items", "My Calendars" (with checkboxes for "Calendar", "Calendar in Archive Folders", and "test"), and "Other Calendars" (with checkboxes for "Istime", "scheduled.ics (7)", and "scheduled.ics"). There are also options for "How to Share Calendars" and "Send a Calendar via E-mail...".

The main calendar grid shows the following events:

- Monday, 23 Nov:** Doctor Who: Watch +1 (19:00-20:00), Catherine (20:00-21:00), Shaft Sky Movies Action/Th (21:00-22:00).
- Tuesday, 24 Nov:** The Mentalist: Hallmark (19:00-20:00), Coronatic (20:00-21:00), BBC New (21:00-22:00).
- Wednesday, 25 Nov:** The Simpsons: Sweet (19:00-20:00), Champion League Live RITE TWO (20:00-21:00), Time Teams: more! (21:00-22:00).
- Thursday, 26 Nov:** The Mentalist: Hallmark (19:00-20:00), Bad Boys Sky Movies Comedy (20:00-21:00), Time Teams: more! (21:00-22:00), V: It's Only the TV! (22:00-23:00).
- Friday, 27 Nov:** Doctor Who: Watch +1 (19:00-20:00), The Mentalist: Hallmark (20:00-21:00), Megastru Grand National (21:00-22:00), MASH Sky Movies Modern Greats (22:00-23:00).
- Saturday, 28 Nov:** NCIS: See No Evil FX (19:00-20:00), The Simpsons: Lisa's (20:00-21:00), Rataouill Disney Cinemagi (21:00-22:00), Doctor Who: Watch (22:00-23:00), Toy Story 2 Disney Cinemagic (17:00-18:00).
- Sunday, 29 Nov:** The Simpsons: Lisa's (19:00-20:00), Rataouill Disney Cinemagi (20:00-21:00), Doctor Who: Watch (21:00-22:00), Time Team Special: Fulbury (22:00-23:00), King Boy (23:00-24:00).



Outline

- 1 Motivation
- 2 Overview
- 3 Scheduler
- 4 Conclusions

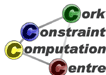


Resources Needed

- Complete application written in ECLiPSe
- Linked to Apache webserver
- Heavily reliant on XML parser, DCG and other tools
- Finite domain and MIP solver in ECLiPSe
- Code size: < 20k lines
- Development effort: 3-4 months

It's all about the Data

- Data availability defines functionality
- Most data is intended for humans, not constraint programs
- Wiki data is the worst, crazy humans!
- XML data feeds sometimes exist, but may be expensive



TVTropes.org: Wiki Madness, but Good Classifiers

romantic future from that day.

- [Work Com](#)
- [Worth It](#): Lutz, after pissing everyone off by choosing Subway when it's his turn to pick where the staff eats.
- [Writer Revolt](#): When forced to write an environmental-themed episode for NBC's Green Week, the writers instead wrote a brutal satire of NBC's own environmental greenwashing, and then did it again the following year, and brought back former VPOTUS AL Gore to "re-cycle" a joke. Also the one episode broadcast during the WGA writer's strike in season 2 (the un-named episode 210) has no writers in it, implying that they are on strike. During the Writer's Strike, the cast of *30 Rock* performed a live episode on-stage off-Broadway to raise money for the strikers.
- [You Look Familiar](#) (Rachel Dratch in the first season)
- [Your Costume Needs Work](#): Jenna met her boyfriend Paul at a Jenna Maroney impersonator contest. He came in first place; she came in fourth.
- [Your Mom](#): A [Most Triumphant Example](#) in "Floyd." After an participating in a Prank war, Frank, Twofer, and Lutz, are able to find Jack's [Weaksauce Weakness](#) of having someone say "Twig and Plums" which makes him leave the room. To get back at them, Jack send them a tape stating that he seduced Frank's mom and threatens to do the same to Twofer's and Lutz's. Danny (who has been helping Jack) pops his head in front of the Camera stating "Hi Frank! Your mom's a hugger."

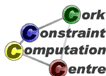
And subverts/parodies/lampshades or otherwise plays with:

- [And Knowing Is Half The Battle](#): Tracy's public service message about the importance of Japanese sex dolls.
- [Ascended Fanboy](#) (Kenneth)
- [Author Tract](#) (an obvious parody of *Studio 60* in an early episode, ending with Lemon confusing herself and saying that she needs to read more)
- [Corrupt Corporate Executive](#): Jack, though classist and greedy, is arguably the most sympathetic character on the show.
- [Double Standard](#): (Lampshaded: "Women are allowed to get angrier over the double standard than men are!")
- [Fake American](#) (subverted; a British actress plays an American pretending to be a Brit and only has to do one line with an American accent)
- [Executive Meddling](#) (portrayed on the show) (Also happened in [Real Life](#) - in Fey's original treatment the [Show Within A Show](#) was a newscast; they told her to go ahead and make it a sketch comedy because that's what she knows)
- [Gilligan Cut](#): Lampshaded by Pete when Tracy insists that he couldn't possibly get in trouble while going on a historical walking tour.



What makes a nice TV evening?

- Sequencing of programs
- Compare: Automatic Generation of Music Programs (Pachet and Roy, 1999)
- React to user's mood
- Can we learn from observing actual behaviour?
 - Rules
 - Programme sequencing
- Micro-controller based logging tool?



Do people really watch TV like this?

- Modelling zapping
- Watching parts of programs only
- TV as background noise

Multi-User Version

- Viewing schedule for groups
- Resource conflicts for recording/storing

Affected by Changed Viewing Habits?

- Already deals with SkyPlayer (Movie on Demand)
- Attempted IPTV lock-in
- Who will provide program data for the Internet



Late Breaking News: Google TV

- Announced yesterday
- Finds TV shows in TV listings and on the Web
- Hardware+software: Partnered with Sony
- Still needs a scheduler



Summary

- Personalized TV Schedules
- A real AI problem
 - Classical AI personal assistant
 - Understand web pages intended for humans
 - Rule based program selection
 - Content based recommender systems
 - Understand/create calendar data
 - Interact with human

