

Programação de TV

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Resumo

Como segundo trabalho da unidade curricular de Programação em Lógica, propus-me desenvolver um algoritmo de Programação de TV capaz de receber um conjunto de séries, um conjunto de *slots* e um conjunto de pares de séries que não possam ser transmitidas no mesmo dia, por questões contratuais, e o número de votos dos espectadores para colocar uma série num dado *slot*. O algoritmo deveria ser capaz de maximizar a satisfação dos espectadores, com base nos seus votos, e minimizar a fatura do aluguer/compra das séries por parte da entidade transmissora.

Para que o processo de escolha fosse eficiente, tornou-se necessário o uso de Programação em Lógica com Restrições. Com esta abordagem consegui garantir tempos de busca da solução que em nada se comparam com o que seria necessário se fosse realizada a estratégia de geração e teste.

1. Introdução

Com este trabalho, pretendi alcançar os seguintes objectivos:

1. desenvolver um algoritmo de Programação de TV capaz de receber um conjunto de séries, um conjunto de *slots* e um conjunto de pares de séries que não possam ser transmitidas no mesmo dia, por questões contratuais,
2. adequar o algoritmo para contabilizar o número de votos por série e *slot* e seleccionar os pares série-*slot* mais votados,
3. minimizar a fatura do aluguer/compra das séries por parte da entidade transmissora,
4. garantir tempos de busca da solução rápidos e eficientes.

Tendo em consideração os objectivos pretendidos e o problema proposto (desenvolver um algoritmo de Programação de TV) impunha-se a criação de uma forma rápida e eficaz de gerar uma combinação de séries e *slots* que satisfaça as restrições previstas.

Em seguida, nas secções seguintes, descrever-se-á o problema e a abordagem utilizada, explicar-se-á o funcionamento do predicado de visualização da solução em modo de texto e discutir-se-ão alguns dos resultados obtidos com diferentes dados de entrada.

2. Descrição do Problema

Tendo por base um conjunto de séries televisivas, das quais se conhece o nome, o preço, a duração do episódio e o intervalo de tempo em que deve ser transmitida, um conjunto de pares de séries que não podem ser exibidas no mesmo dia e um conjunto de *slots* temporais em que se devem encaixar algumas destas séries, deseja-se criar um algoritmo capaz de gerir as variáveis anteriores e adequar correspondências de *slots* com séries de acordo com as preferências manifestadas pelos espectadores e a fatura total a pagar pelas séries, sendo desejável maximizar o número de votos dos espectadores e minimizar a fatura total.

3. Abordagem

3.1 Variáveis de Decisão

Criou-se uma lista de identificadores (ids) de séries, chamada “SeriesBySlot”, em que o índice do elemento da lista corresponde ao identificador de um *slot*. Todos os *slots* devem ser ocupados por uma série, mas nem todas as séries têm de ocorrer na lista. Como é uma lista de identificadores de séries, o seu domínio estará entre 1 e o valor do maior identificador de série existente na base de factos. Assume-se que os identificadores são consecutivos e estão guardados na base de factos por ordem crescente.

3.2 Restrições

Cada série tem uma certa duração (múltipla de 30 minutos), ocupando um número de *slots* que pode ser calculado computando “duração a dividir por 30”, pois a duração é em minutos, e cada *slot* corresponde a 30 minutos. Assim sendo, uma série tem de ocorrer um número de vezes múltiplo do número de *slots* que ocupa. Tal foi implementado usando o predicado “count()” para cada série em “SeriesBySlot” e indicando que a contagem devolvida corresponde a um múltiplo do número de *slots* ocupados pela série.

Os *slots* de um episódio da série devem ser em horários consecutivos (restrição rígida). Esta restrição foi implementada calculando para cada série que *slots* a contém (usando “myElement()”) e, indicando, para cada *slot*, que deve existir outro *slot* que contenha a série e cuja distância temporal seja de 30 minutos. No entanto, parece que este predicado não está a funcionar, apesar de não interferir com o resto do funcionamento do algoritmo. Há casos em que uma série só ocupa um *slot* ou não está a ser contemplada pela solução, essas situações estão previstas, sendo que o predicado simula a existência de um outro *slot*.

O *slot* alocado a uma série tem de corresponder a uma hora do dia em que a série pode ser emitida, comparando com os atributos “hora mínima” e “hora máxima” da série com a hora a que o *slot* corresponde. Como estes atributos correspondem a um intervalo de tempo, esta é uma restrição flexível.

Duas séries não podem pertencer a *slots* cujo atributo “dia” é igual, se assim estiver indicado na base de factos (restrição rígida). Para impedir que tal aconteça,

para cada par de séries que não podem ser emitidas no mesmo dia, indica-se para cada *slot* da série 1 que qualquer um dos *slots* da série 2 não pode possuir como atributo “dia” o mesmo dia.

3.3 Função de Avaliação

Neste problema tenciona-se minimizar o gasto monetário total e maximizar o número de espectadores satisfeitos.

Usando um processo ganancioso tenta-se minimizar a soma dos rácios entre o preço da série e o número de votos de cada par série-*slot*, pois quanto maior o número de votos e menor o preço, menor será o rácio.

Ao nível da implementação, para cada *slot*, ou seja, para cada índice de “SeriesBySlot”, pesquisa-se qual é o id da série que este possui. Com aquele id, calcula-se a posição do preço na lista de séries, pesquisando-se essa posição. De seguida, usando o predicado “element()”, realiza-se uma pesquisa análoga para se saber a posição do número de votos correspondente ao par série-*slot* e, por fim, divide-se o preço pelo número de votos. O somatório deste valor para todos os *slots*, corresponde a uma pontuação total que deverá ser minimizada.

3.4 Estratégia de Pesquisa

Ao nível da pesquisa de soluções, foram testadas três opções que pareceram fazer sentido: *ffc*, *occurrence* e *bisect*.

A opção “*occurrence*” foi a única que se manteve a uso, pois em relação ao *default* e, até mesmo a combinações das três opções, reduziu muito consideravelmente o tempo de pesquisa.

A opção “*ffc*”, possivelmente, não foi eficaz na redução do tempo de pesquisa, pois necessita de escolher a variável mais suscetível a gerar o falhanço e, para isso, precisa de verificar quantas restrições se encontram suspensas para cada variável.

Para além da opção “*occurrence*”, também é utilizada a opção “*all*” para que sejam mostradas combinações cada vez melhores, em vez de ser necessário esperar pela combinação óptima e “*minimize*” para minimizar o valor gerado pela função de avaliação.

4. Visualização da Solução

O predicado “*show()*” recebe a lista de séries ordenada por *slots* e, sabendo o id da série e o id do *slot* com base no índice, acede aos factos “*seriesName*”, “*slot*” e “*slotDay*” com os ids correspondentes e, assim, obtém o nome da série e o horário do *slot*, apresentando essa informação.

5. Resultados

Nome do ficheiro	Número de séries	Número de <i>slots</i>	Tempo pré- <i>labeling</i>	Tempo de <i>labeling</i>
dataXS.pl	10	5	0.04s	0.02s
dataS.pl	57	10	0.5s	70.56s
dataM.pl	57	25	13.52s	124.26s
dataL.pl	57	35	44.48s	—————
dataXL.pl	57	55	254.33s	—————

Nome do ficheiro	Retomadas	Envolvimentos	Podas	Retrocessos	Restrições criadas
dataXS.pl	79 214	39 526	44 482	16	2 955
dataS.pl	304 270 577	152 914 027	155 598 872	28 930	39 405
dataM.pl	388 272 823	217 638 727	218 030 294	5334	564 166
dataL.pl	—————	—————	—————	—————	—————
dataXL.pl	—————	—————	—————	—————	—————

Estes valores correspondem à pesquisa por uma solução óptima. Pode-se verificar que os tempos de processamento são bastante razoáveis, dado o número de combinações possíveis. A velocidade de *labeling* seria muito mais rápida se não fosse necessário recorrer aos predicados “contiguousSeries()” e “restrictNoSameDay()”, o que indica que se fosse possível reduzir o número de “or” lógicos presentes nestes dois predicados, a solução seria obtida muito mais depressa. De referir que o predicado “contiguousSeries()” está a ser utilizado, mas não está a produzir resultados visíveis, sendo que aumenta o tempo de resolução, mas deve ser utilizado, pois a solução correcta deve recorrer a uma versão corrigida deste predicado.

Algo que não está presente nestes dados, mas pode ser verificado tentando correr os testes em anexo, é que usando a opção de *labeling* “all”, encontram-se boas soluções em tempo útil, mesmo para o ficheiro “dataXL.pl”, sendo que se for fornecido tempo suficiente para o algoritmo correr, acabar-se-á por se chegar à solução óptima.

6. Conclusões e Trabalho Futuro

A utilização de Programação em Lógica com Restrições aumenta significativamente a eficiência da resolução de problemas como este em que existe um elevado número de combinações possíveis a testar.

A solução apresentada possui como vantagem o reduzido tempo necessário para encontrar uma solução ótima, no entanto é bastante trabalhosa a sua criação e, em certos casos, a análise do que o algoritmo faz. Tendo em consideração a solução apresentada, esta solução torna-se ainda mais eficaz na pesquisa de soluções cada vez melhores, em vez da pesquisa directa da solução óptima.

As únicas melhorias cuja diferença seria significativa para o funcionamento do algoritmo seria a correção da implementação do predicado “contiguousSeries()” que não se encontra a realizar o esperado, apesar de não interferir com a busca de

soluções e a redução do número de “or” lógicos que existem em “contiguousSeries()” e “restrictNoSameDay()”, pois aparentam aumentar muito o tempo de pesquisa da solução.

Bibliografia

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Moodle U.Porto –Programação em Lógica ,
<https://moodle.up.pt/course/view.php?id=1556>

Anexo

TV Programation Optimizer.pl

```
/*
The number of available series must be always greater than the number of slots to fill.
The facts stored must be ordered by id and the first id must be 1.

series(SeriesId, Price, Duration, MinHour, MaxHour).      % Duration is multiple of 30
and MinHour < MaxHour.
noSameDay(SeriId1, SeriId2).
seriesName(SeriesId, SeriesName).
slot(SlotId, DayId, Hour, Minute).      % The duration of a slot is 30 minutes.
slotDay(DayId, DayName).

Row = seriId
Column = slotId
preferences([
                [NumVotes, NumVotes, ...],
                [NumVotes, NumVotes, ...],
                [NumVotes, NumVotes, ...],
                ...
            ]).      % NumVotes must be greater than 0
*/

:- use_module(library(clpfd)).
:- use_module(library(lists)).
:- load_files(dataS).

betterSol :-
    reset_timer,
    flatData(Series, Slots, Preferences),
    % Variables declaration
    length(Slots, SlotsLength),
    NumSlots is SlotsLength // 4, % 4 = number of arguments of slot()
    length(SeriesBySlot, NumSlots), % SeriesBySlot -> list of SeriesId which
index is the SlotId
    % Variables domain declaration
    length(Series, SeriesLength),
    Max is SeriesLength // 5, % 5 = number of arguments of series()
    domain(SeriesBySlot, 1, Max),
    % Restrictions declaration
    numSeriesOccurs(Series, SeriesBySlot),
    contiguousSeries(SeriesBySlot, SeriesBySlot, Series, Slots),
    restrictSchedule(SeriesBySlot, Series, Slots),
    restrictNoSameDay(SeriesBySlot, Slots),
    % Evaluation function
    calcValues(SeriesBySlot, Series, Preferences, AllSlotsValue),
```

```

print_time,
% Search for solutions
write('Labeling beginning'),
nl,
reset_timer,
labeling([minimize(AllSlotsValue), occurrence, all], SeriesBySlot),
print_time,
fd_statistics,
nl,
show(SeriesBySlot),
format("Value: ~d~n", [AllSlotsValue]),
nl,
fail.    % due to the use of 'all' in 'labeling'
betterSol.

flatData(Series, Slots, Preferences) :-
    findall([A,B,C,D,E], series(A,B,C,D,E), SeriesMatrix),
    findall([A,B,C,D], slot(A,B,C,D), SlotsMatrix),
    preferences(PreferencesMatrix),
    append(SeriesMatrix, Series),
    append(SlotsMatrix, Slots),
    append(PreferencesMatrix, Preferences).

% limits the number of occurrences of the id of a series in the SeriesBySlot list (0 or
NumSlots occurrences)
numSeriesOccurs([SeriesId, _, Duration, _, _ | OtherSeries], SeriesBySlot) :-
    NumSlots #= Duration // 30,
    count(SeriesId, SeriesBySlot, #=, X),
    X #= _N * NumSlots, % _N allows a series to be presented 0, 1 or more times
(_N is always greater or equal to 0)
    numSeriesOccurs(OtherSeries, SeriesBySlot).
numSeriesOccurs([], _).

% calculate the sum of ratios Price / NumVotes that must be minimized by 'labeling'
calcValues(SeriesBySlot, Series, Preferences, AllSlotsValue) :-
    length(SeriesBySlot, Length),
    calcValuesAux(SeriesBySlot, Length, Series, Preferences, 0, AllSlotsValue).

calcValuesAux(SeriesBySlot, SeriesBySlotPos, Series, Preferences,
TempAllSlotsValue, AllSlotsValue) :-
    SeriesBySlotPos > 0,
    calcValue(SeriesBySlot, SeriesBySlotPos, Series, Preferences, SlotValue),
    TempAllSlotsValue2 #= TempAllSlotsValue + SlotValue,
    SeriesBySlotPos2 is SeriesBySlotPos - 1,
    calcValuesAux(SeriesBySlot, SeriesBySlotPos2, Series, Preferences,
TempAllSlotsValue2, AllSlotsValue).
calcValuesAux(_, 0, _, _, AllSlotsValue, AllSlotsValue).

```

```

calcValue(SeriesBySlot, SlotId, Series, Preferences, Value) :-
    element(SlotId, SeriesBySlot, SeriesId),
    % position of the actual series price on Series
    Pos #= (SeriesId - 1) * 5 + 2,
    element(Pos, Series, Price),
    % position of the actual series and slot number of votes on Preferences
    length(SeriesBySlot, NumSlots),
    Pos2 #= (SeriesId - 1) * NumSlots + SlotId,
    element(Pos2, Preferences, NumVotes),
    % calculate the ratio - we want to minimize the Price and maximize NumVotes,
    so we must minimize the ratio
    Value #= Price / NumVotes.

```

```

% make a series be contiguous
contiguousSeries([SeriesId | RestSeriesBySlot], SeriesBySlot, Series, Slots) :-
    myElement(PosList, SeriesBySlot, SeriesId),
    contiguousSeriesAux1(PosList, SeriesBySlot, Slots, 0, Exist),
    % must exist at least 1 pair of slots with 30 minutes of difference or the series
    occupies 0 or 1 slots (for both cases Exist #\= 0)
    Exist #\= 0,
    contiguousSeries(RestSeriesBySlot, SeriesBySlot, Series, Slots).
contiguousSeries([], _, _, _).

```

```

contiguousSeriesAux1([SlotId1 | OtherSlotIds], SeriesBySlot, Slots, TmpExist, Exist) :-
    contiguousSeriesAux2(SlotId1, OtherSlotIds, SeriesBySlot, Slots, TmpExist2,
    Exist),
    TmpExist3 #= TmpExist + TmpExist2,
    contiguousSeriesAux1(OtherSlotIds, SeriesBySlot, Slots, TmpExist3, Exist).
contiguousSeriesAux1([], _, _, Exist, Exist).

```

```

contiguousSeriesAux2(SlotId1, [SlotId2 | OtherSlotIds], SeriesBySlot, Slots, TmpExist,
Exist) :-
    % verify if the positions are valid indexes (see myElement()), if not give a valid
    index (1) that will be ignored
    (SlotId1 #= 0 #\ TmpSlotId1 #= 1) #V (SlotId1 #\= 0 #\ TmpSlotId1 #= SlotId1),
    (SlotId2 #= 0 #\ TmpSlotId2 #= 1) #V (SlotId2 #\= 0 #\ TmpSlotId2 #= SlotId2),
    % position of the slot day in Slots
    Pos1 #= (TmpSlotId1 - 1) * 4 + 2,
    element(Pos1, Slots, Day1),
    % position of the slot hour in Slots
    Pos2 #= (TmpSlotId1 - 1) * 4 + 3,
    element(Pos2, Slots, Hour1),
    % position of the slot minute in Slots
    Pos3 #= (TmpSlotId1 - 1) * 4 + 4,
    element(Pos3, Slots, Minute1),
    % position of the slot day in Slots
    Pos4 #= (TmpSlotId2 - 1) * 4 + 2,
    element(Pos4, Slots, Day2),

```



```

% position of the slot hour in Slots
Pos5 #=(TmpSlotId2 - 1) * 4 + 3,
element(Pos5, Slots, Hour2),
% position of the slot minute in Slots
Pos6 #=(TmpSlotId2 - 1) * 4 + 4,
element(Pos6, Slots, Minute2),
% Minute = 0 or Minute = 30
((SlotId1 #= 0 #\ SlotId2 #= 0) #\ % when the series occupies 0 or 1 slots
(Day1 #= Day2 #\ Hour1 #= Hour2 #\ Minute1 #\ Minute2) #\
(Day1 #= Day2 #\ Hour1 #\ Hour2 #\ Minute1 #\ Minute2) #\
(Day1 #\ Day2 #\ Hour1 #\ Hour2 #\ Minute1 #\ Minute2)) #<=> Tmp,
TmpExist2 #= TmpExist + Tmp,
contiguousSeriesAux2(SlotId1, OtherSlotIds, SeriesBySlot, Slots, TmpExist2,
Exist).
contiguousSeriesAux2(_, [], _, _, Exist, Exist).

% restrict the schedule of a series (the chosen slot must be between MinHour and
MaxHour)
restrictSchedule(SeriesBySlot, Series, Slots) :-
    length(SeriesBySlot, Length),
    restrictScheduleAux(SeriesBySlot, Length, Series, Slots).

restrictScheduleAux(SeriesBySlot, SeriesBySlotPos /* = SlotId */, Series, Slots) :-
    SeriesBySlotPos > 0,
    element(SeriesBySlotPos, SeriesBySlot, SeriesId),
    % positions of MaxHour and MinHour on Series
    Pos1 #=(SeriesId - 1) * 5 + 4,
    Pos2 #=(SeriesId - 1) * 5 + 5,
    element(Pos1, Series, MinHour),
    element(Pos2, Series, MaxHour),
    % position of Hour on Slots
    Pos3 #=(SeriesBySlotPos - 1) * 4 + 3,
    element(Pos3, Slots, Hour),
    MinHour #=< Hour #\ MaxHour #> Hour,
    SeriesBySlotPos2 is SeriesBySlotPos - 1,
    restrictScheduleAux(SeriesBySlot, SeriesBySlotPos2, Series, Slots).
restrictScheduleAux(_, 0, _, _).

% restrict the series that must not occur in the same day
restrictNoSameDay(SeriesBySlot, Slots) :-
    findall(SeriesId1-SeriesId2, noSameDay(SeriesId1, SeriesId2), List),
    restrictNoSameDayAux1(List, SeriesBySlot, Slots).

restrictNoSameDayAux1([SeriesId1-SeriesId2 | RestNoSameDay], SeriesBySlot, Slots)
:-
    myElement(PosList1, SeriesBySlot, SeriesId1),
    myElement(PosList2, SeriesBySlot, SeriesId2),
    restrictNoSameDayAux2(PosList1, PosList2, Slots),

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```

    restrictNoSameDayAux1(RestNoSameDay, SeriesBySlot, Slots).
restrictNoSameDayAux1([], _, _).

restrictNoSameDayAux2([Pos|RestPosList1], PosList2, Slots) :-
    restrictNoSameDayAux3(Pos, PosList2, Slots),
    restrictNoSameDayAux2(RestPosList1, PosList2, Slots).
restrictNoSameDayAux2([], _, _).

restrictNoSameDayAux3(Pos1 /* = SlotId1*/, [Pos2|RestPosList2], Slots) :-
    % verify if the positions are valid indexes (see myElement()), if not give a valid
    index (1) that will be ignored
    (Pos1 #= 0 #\ Pos3 #= 1) #V (Pos1 #\= 0 #\ Pos3 #= Pos1),
    (Pos2 #= 0 #\ Pos4 #= 1) #V (Pos2 #\= 0 #\ Pos4 #= Pos2),
    % position of Day on Slots
    Pos5 #= (Pos3 - 1) * 4 + 2,
    element(Pos5, Slots, Day1),
    Pos6 #= (Pos4 - 1) * 4 + 2,
    element(Pos6, Slots, Day2),
    Pos1 #= 0 #V Pos2 #= 0 #V Day1 #\= Day2,
    restrictNoSameDayAux3(Pos1, RestPosList2, Slots).
restrictNoSameDayAux3(_, [], _).

% find all the positions where Elem occurs in L (a list of domain variables)
myElement(PosList, L, Elem) :-
    length(L, Length),
    myElementAux(PosList, L, Elem, Length, []).

myElementAux(PosList, L, Elem, Pos, TmpPosList) :-
    Pos > 0,
    element(Pos, L, E),
    E #= Elem #<=> Exist,
    % insert 0 in the list if the position does not have the element (element() never
    gives Pos #= 0)
    (Exist #= 0 #\ Tmp #= 0) #V (Exist #= 1 #\ Tmp #= Pos),
    Pos2 is Pos - 1,
    myElementAux(PosList, L, Elem, Pos2, [Tmp|TmpPosList]).
myElementAux(PosList, _, _, 0, PosList).

reset_timer :- statistics(walltime,_).
print_time :-
    statistics(walltime,[_ ,T]),
    TS is ((T//10)*10)/1000,
    nl, write('Time: '), write(TS), write('s'), nl, nl.

show(SeriesBySlot) :-
    showAux(SeriesBySlot, 1).

showAux([SeriesId | Rest], SlotId) :-

```

```
    seriesName(SeriesId, Name),  
    slot(SlotId, DayId, Hour, Minute),  
    slotDay(DayId, Day),  
    format('~s ~s ~dh~dm~N', [Name, Day, Hour, Minute]),  
    SlotId2 is SlotId + 1,  
    showAux(Rest, SlotId2).  
showAux([], _).
```

dataXS.pl

```
series(1, 28692, 120, 13, 19).
series(2, 10467, 90, 2, 19).
series(3, 15903, 30, 17, 18).
series(4, 14235, 30, 4, 17).
series(5, 14190, 90, 8, 13).
series(6, 12215, 30, 2, 6).
series(7, 18063, 120, 1, 4).
series(8, 21780, 60, 3, 11).
series(9, 1299, 90, 3, 19).
series(10, 32521, 90, 10, 13).
```

```
noSameDay(9, 10).
```

```
seriesName(1, 'Westworld').
seriesName(2, 'The Grand Tour').
seriesName(3, 'The Big Bang Theory').
seriesName(4, 'The Walking Dead').
seriesName(5, 'The Simpsons').
seriesName(6, 'Legends of Tomorrow').
seriesName(7, 'Vikings').
seriesName(8, 'The Flash').
seriesName(9, 'Arrow').
seriesName(10, 'Supergirl').
```

```
slot(1, 5, 14, 30).
slot(2, 5, 15, 30).
slot(3, 5, 15, 0).
slot(4, 5, 16, 0).
```

```
slot(5, 5, 16, 30).
```

```
slotDay(1, 'Monday').
slotDay(2, 'Tuesday').
slotDay(3, 'Wednesday').
slotDay(4, 'Thursday').
slotDay(5, 'Friday').
slotDay(6, 'Saturday').
slotDay(7, 'Sunday').
```

```
preferences([
    %      1,      2,      3,      4,      5
    [ 2108, 2307, 11560, 32379, 32176], % 1
    [ 6353, 11057, 6741, 19792, 6554], % 2
```

[	1353,	29707,	13441,	16926,	3263],	% 3
[	5689,	13651,	999,	19375,	29756],	% 4
[	7720,	29422,	2648,	15381,	21342],	% 5
[	24853,	11366,	26295,	24101,	21289],	% 6
[	19440,	13928,	18557,	6902,	20948],	% 7
[	31773,	9285,	13108,	12133,	16969],	% 8
[	5879,	16755,	4605,	29074,	23463],	% 9
[	29001,	6922,	6924,	9825,	6338]% 10	

)).

```

Resumptions: 5501
Entailments: 2947
Prunings: 3125
Backtracks: 2
Constraints created: 0

```

```

Arrow Friday 14h30m
Arrow Friday 15h30m
Arrow Friday 15h0m
The Walking Dead Friday 16h0m
The Walking Dead Friday 16h30m
Value: 0

```

yes

dataS.pl

```
series(1, 20560, 90, 0, 11).
series(2, 25210, 30, 4, 17).
series(3, 11365, 30, 12, 16).
series(4, 8783, 30, 2, 19).
series(5, 23174, 60, 17, 21).
series(6, 6540, 90, 1, 19).
series(7, 24267, 30, 0, 6).
series(8, 18045, 60, 13, 15).
series(9, 32439, 120, 18, 23).
series(10, 3425, 60, 1, 13).
series(11, 4113, 60, 6, 13).
series(12, 6273, 30, 2, 9).
series(13, 22128, 90, 3, 16).
series(14, 16018, 120, 11, 14).
series(15, 24440, 120, 2, 15).
series(16, 30095, 90, 2, 3).
series(17, 10496, 30, 11, 14).
series(18, 18916, 30, 1, 21).
series(19, 18651, 60, 9, 13).
series(20, 2846, 30, 15, 16).
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Resumptions: 1136044
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Prunings: 621820
Backtracks: 30
Constraints created: 0

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The Grand Tour Sunday 11h30m
The Flash Tuesday 6h0m
The Flash Monday 21h30m
The Grand Tour Thursday 4h30m
The Grand Tour Tuesday 7h30m
The Grand Tour Saturday 4h30m
The Grand Tour Tuesday 9h0m
The Grand Tour Tuesday 1h0m
Criminal Minds Wednesday 19h30m
The Grand Tour Sunday 6h0m
The Grand Tour Tuesday 1h30m
The Grand Tour Sunday 13h30m
The Flash Saturday 18h30m
The Simpsons Tuesday 15h0m
The Grand Tour Monday 9h0m
The Simpsons Tuesday 18h0m
The Grand Tour Wednesday 6h0m
Gotham Friday 0h30m
Criminal Minds Saturday 19h0m
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The Grand Tour Friday 5h30m
The Grand Tour Wednesday 13h0m
Value: 0

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seriesName(38, 'Uma casa na pradaria').
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