Programação de grade de horários para escolas do ensino fundamental e médio

Proposta

Solução manual x solução computacional.

1. Solução Inicial

Como está sendo feito a construção da solução inicial.

Para construir uma solução inicial precisamos de:

- Definir um professor
- Definir uma turma
- Definir um dia
- Definir um horário
- Preencher que o professor p, da aula para a turma t, no dia d e no horário h.

Isso nos gera a seguinte variável de decisão:

x[p][t][d][h]

No artigo:

- Definindo o melhor professor e turma baseado na taxa de urgência (veremos a seguir). Forma determinística.

- Definindo o dia e horário de forma totalmente aleatória.

Na pesquisa:

- Definindo o melhor professor e turma baseado na taxa de urgência (veremos a seguir). Mas sorteando entre os “alfas” melhores professores/turma.

- Definindo o dia e horário baseado em uma heurística de pontuação. Se houver horários com a mesma pontuação há sorteio.

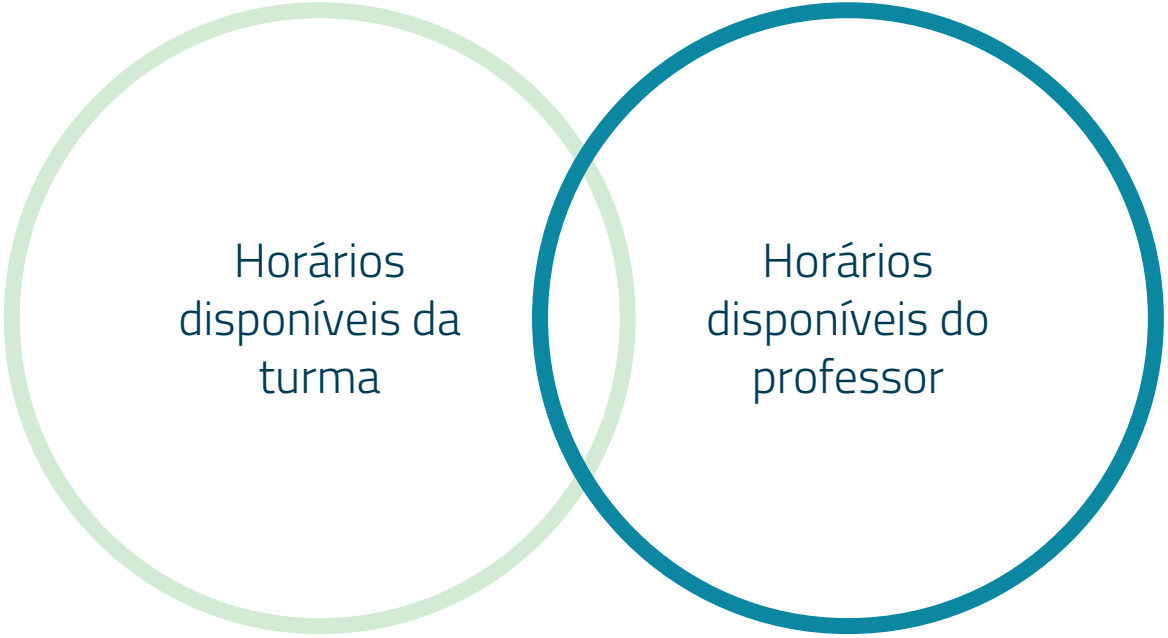
Taxa de urgência:

$$\theta_p = \left(\sum_{t \in T} R_{pt}\right) / (N_{disp} + 1) \qquad (56)$$

R[p][t] → Número de aulas que o professor p da para a turma t.

N_disp → Quantidade de horários disponíveis para alocação de uma aula.

Quantidade de horários disponíveis para alocação de uma aula



Heurística de pontuação para melhor horário de aula.

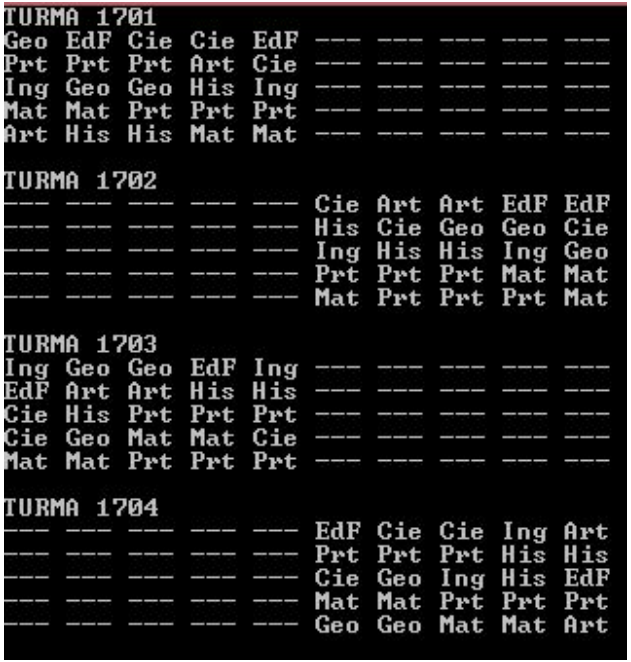
Pontuação inicial = 0;

- +10 pontos ⟶ Se houver aula anterior ou posterior.
- + 10 pontos ⟶ Se já tem aula naquele dia + 10 pontos. (Já tem que ir para a escola mesmo)
- - 30 pontos ⟶ Se já tem duas aulas (para professores que dão até 4 aulas) ou três aulas(para os demais) para aquela turma naquele dia.
- - 20 pontos ⟶ Se não tem preferência por aquele horário.

Quanto maior a pontuação, melhor.

2. Resultados

Resultado 1


TURMA 1701
Geo EdF Cie Cie EdF --- --- --- --- ---
Prt Prt Prt Art Cie --- --- --- --- ---
Ing Geo Geo His Ing --- --- --- --- ---
Mat Mat Prt Prt Prt --- --- --- --- ---
Art His His Mat Mat --- --- --- --- ---
TURMA 1702
--- --- --- --- --- Cie Art Art EdF EdF
--- --- --- --- --- His Cie Geo Geo Cie
--- --- --- --- --- Ing His His Ing Geo
--- --- --- --- --- Prt Prt Prt Mat Mat
--- --- --- --- --- Mat Prt Prt Prt Mat
TURMA 1703
Ing Geo Geo EdF Ing --- --- --- --- ---
EdF Art Art His His --- --- --- --- ---
Cie His Prt Prt Prt --- --- --- --- ---
Cie Geo Mat Mat Cie --- --- --- --- ---
Mat Mat Prt Prt Prt --- --- --- --- ---
TURMA 1704
--- --- --- --- --- EdF Cie Cie Ing Art
--- --- --- --- --- Prt Prt Prt His His
--- --- --- --- --- Cie Geo Ing His EdF
--- --- --- --- --- Mat Mat Prt Prt Prt
--- --- --- --- --- Geo Geo Mat Mat Art

Resultado 2

```
TURMA 1701
EdF EdF Geo Prt Prt --- --- --- --- ---
Geo Geo Mat Mat Ing --- --- --- --- ---
Ing Cie Cie Prt Prt --- --- --- --- ---
Art Prt Prt His His --- --- --- --- ---
Cie His Art Mat Mat --- --- --- --- ---

TURMA 1702
--- --- --- --- --- Ing EdF EdF Geo Geo
--- --- --- --- --- Mat Prt Mat Prt Prt
--- --- --- --- --- Prt Prt Prt Ing Cie
--- --- --- --- --- Cie Art Geo His Art
--- --- --- --- --- His His Cie Mat Mat

TURMA 1703
Prt Prt Prt Geo Ing --- --- --- --- ---
Ing Mat Geo Geo Mat --- --- --- --- ---
Prt Prt Prt Cie Cie --- --- --- --- ---
His Art Art Cie EdF --- --- --- --- ---
EdF Mat Mat His His --- --- --- --- ---

TURMA 1704
--- --- --- --- --- EdF Prt Prt Prt EdF
--- --- --- --- --- Ing Art Geo Mat Mat
--- --- --- --- --- Cie Cie Geo Geo Ing
--- --- --- --- --- His His Prt Prt Prt
--- --- --- --- --- Cie Mat Mat Art His
```

Resultado 3

```
TURMA 1701
Prt Prt Prt Geo Geo --- --- --- --- ---
Geo Prt Prt Prt Ing --- --- --- --- ---
His Art Art EdF EdF --- --- --- --- ---
Cie His His Mat Mat --- --- --- --- ---
Ing Mat Mat Cie Cie --- --- --- --- ---

TURMA 1702
--- --- --- --- --- Ing Ing Art Geo Art
--- --- --- --- --- Prt His His Prt Prt
--- --- --- --- --- Prt Prt Prt EdF EdF
--- --- --- --- --- Mat Mat His Cie Cie
--- --- --- --- --- Cie Geo Mat Mat Geo

TURMA 1703
Art Art EdF Prt Prt --- --- --- --- ---
Prt Geo Geo Ing Prt --- --- --- --- ---
EdF His His Cie Cie --- --- --- --- ---
His Mat Mat Ing Cie --- --- --- --- ---
Prt Prt Geo Mat Mat --- --- --- --- ---

TURMA 1704
--- --- --- --- --- Art Art Ing Ing Geo
--- --- --- --- --- Prt Prt Geo EdF Prt
--- --- --- --- --- EdF Cie Cie His His
--- --- --- --- --- Cie His Mat Mat Geo
--- --- --- --- --- Mat Mat Prt Prt Prt
```

3. Dados

Manuais

	A	B	C	D	E	F	G
1		Professores					
2		Disciplina	Carga horária	Qtd. tempos	Turmas e quantidade de aula para tais	Dias e turnos presentes	Preferências
3	A	História	30h	24	8 turmas = 1701(3), 1702(3), 1703(3), 1704(3), 1801(3), 1803(3), 1901(3), 1903(3)	Seg, Quarta, Quinta, Sexta	
4	B	Ed. Física	16h	12	6 turmas = 1701(2), 1702(2), 1704(2), 1901(2), 1902(2), 1802(2)	Seg, Terça, Quarta	Não chegar muito cedo e sair muito tarde
5	C	Ciências	16h	12	4 turmas = 1901(3), 1902(3), 1903(3), 1801(3)	Seg, Terça, Quarta	Sair cedo (3º tempo da tarde)
6	D	Artes	16h	12	6 turmas = 1701(2), 1703(2), 1704(2), 1903(2), 1802(2), 1803(2)	Quarta, Sexta	Não chegar cedo
7	E	Matemática	16h	12	3 turmas = 1901(6), 1902(6), 1903(6)	Seg, Terça, Quarta, Quinta	Sair no 3º tempo da tarde
8	F	Matemática	16h	12	2 turmas = 1802(6), 1803(6)	Seg(T), Terça(T), Quarta(T), Quinta(T)	
9	G	Inglês	16h	12	6 turmas = 1701(2), 1702(2), 1703(2), 1801(2), 1901(2), 1803(2)	Terça(T), Quarta(M), Sexta	
10	H	Geografia	16h	30	4 turmas = 1703(3), 1701(3), 1901(3), 1902(3)	Terça, Quarta, Quinta, Sexta	Deixar a sexta livre
11	I	História	40h / **8h**	30 / **6**	2 turmas = 1902(3), 1802(3)	Seg, Terça, Quinta(T), Sexta(M)	
12	J	Português	40h	12	6 turmas = 1901(4), 1902(4), 1903(4), 1702(6), 1803(4), 1802(4)	Seg, terça, Quinta, Sexta	
13	K	Matemática	16h / **8h**	12 / **6**	1 turma = 1801(6)	Quinta(M), Sexta(M)	
14	L	Ciências	16h	12	4 turmas = 1701(3), 1702(3), 1703(3), 1704(3)	Seg, Quarta, Sexta	
15	M	Inglês	16h / **10h**	12 / **8**	4 turmas = 1704(2), 1802(2), 1903(2), 1902(2)	Terça, Quarta, Quinta, Sexta	
16	N	Portugues	22	24	4 turmas = 1701(6), 1703(6), 1704(6), 1801(4)	Seg, Terça, Quarta(M), Quinta	
17	O	Matemática	24	16	4 turmas = 1701(4), 1702(4), 1703(4), 1704(4)	Quarta, Quinta, Sexta(T)	
18	P	Geografia			6 turmas = 1702(3), 1704(3), 1801(3), 1802(3), 1803(3), 1903(3)		
19	Q	Artes			4 turmas = 1702(2), 1801(2), 1901(2), 1902(2)		
20	R	Ed. Física			4 turmas = 1703(2), 1801(2), 1803(2), 1903(2)		
21	S	Ciências			2 turmas = 1802(3), 1803(2)		

Json


```
{
    "n_dias_com_aula": "5",
    "n_horarios_por_dia": "10",
    "n_turmas": "10",
    "n_professores": "19",
    "n_turnos": "2",
    "n_materias": "8",
    "quadras": "1",
    "materias": [
        "Mat",
        "Prt",
        "Cie",
        "His",
        "Geo",
        "Ing",
        "EdF",
        "Art"
    ],
    "aula_professor_turma": [
        [3, 3, 3, 3, 3, 0, 3, 3, 0, 3],
        [2, 2, 0, 2, 0, 2, 0, 2, 2, 0],
        [0, 0, 0, 0, 3, 0, 0, 3, 3, 3],
        [2, 0, 2, 2, 0, 2, 2, 0, 0, 2],
        [0, 0, 0, 0, 0, 0, 0, 6, 6, 6],
        [0, 0, 0, 0, 0, 6, 6, 0, 0, 0],
        [2, 2, 2, 0, 2, 0, 2, 2, 0, 0],
        [3, 0, 3, 0, 0, 0, 0, 3, 3, 0],
        [0, 0, 0, 0, 0, 3, 0, 0, 3, 0],
        [0, 6, 0, 0, 0, 4, 4, 4, 4, 4],
        [0, 0, 0, 0, 6, 0, 0, 0, 0, 0],
        [3, 3, 3, 3, 0, 0, 0, 0, 0, 0],
        [0, 0, 0, 2, 0, 2, 0, 0, 2, 2],
        [6, 0, 6, 6, 4, 0, 0, 0, 0, 0],
        [4, 4, 4, 4, 0, 0, 0, 0, 0, 0],
        [0, 3, 0, 3, 3, 3, 3, 0, 0, 3],
        [0, 2, 0, 0, 2, 0, 0, 2, 2, 0],
        [0, 0, 2, 0, 2, 0, 2, 0, 0, 2],
        [0, 0, 0, 0, 0, 3, 3, 0, 0, 0]
    ],
    "professor_disciplina": [
        3, 6, 2, 7, 0, 0, 5, 4, 3, 1, 0, 2, 5, 1, 0, 4, 7, 6, 2
    ],
    "turma_turno": [
        0, 1, 0, 1, 0, 1, 1, 0, 0, 1
    ],
    "turma_nome": [
        1701, 1702, 1703, 1704, 1801, 1802, 1803, 1901, 1902, 1903
    ]
}
```

4. Proposta

GRASP

- Testar lista restrita baseado na Qualidade (atualmente está baseado na Cadinalidade)
- Implementar fase de busca local

Produto

OBRIGADO!

Alguma dúvida?

Você pode me encontrar:

matheusfelipecorreaalves@gmail.com

CRÉDITOS

- **Vânia Nobre de Sousa, Antônio Carlos Moretti e Valéria Abrão**, Programação de grade de horário em escolas do ensino fundamental e médio, *Simpósio Brasileiro de Pesquisa Operacional 2008*

- Link para o artigo