Student Block Assignments: a data driven algorithm

Saving Time and Resources in the Creation of Block Assignments for Dental Students

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Purpose:

-an efficient and flexible approach
for the assignment of students
to block assignments (rotations)
using a data driven algorithm.

Abstract:

Each Dental School has an approach for creating a schedule for students to rotate through the myriad of specialty clinics and experiences (Block Assignments), i.e., Oral Surgery, Pediatric, CPR class, etc. Your school has probably tried them all:
- butcher paper
- fancy excel manipulations
- 'teams'

The process is usually done by a team of people who have been doing it 'forever' or that requires hours of the school's IT department, costing valuable, scarce resources.

By developing a data driven approach with a simple scheduling algorithm, the student and calendar information as well as basic parameters of each specialty are entered into data tables. This straightforward data entry can be done by any data entry staff person. The main algorithm is then easily manipulated by one non-IT staff person with minimal training.

By creating an algorithm that can be run repeatedly, the assignments are created to fill each specialty for the duration of the assignment. The algorithm is run for the longer assignment periods first, then each successive block is added to the schedules. 'Minimal clinic' sessions are also created between assignments. Holidays and Non-Clinic sessions are easily set in the data tables and skipped by the algorithm. Special situations or priority assignments can be hand entered first, which the algorithm then knows to skip..

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Data Tables are the Central Communication Mechanism

Data Tables contain incoming
-parameters
-block and student identification data sets
-calendar data sets
which are acted upon by the
-algorithm
and are used for outgoing information for
-exported block 'appointments'
-quality assurance
-reports

Data Types Selected to 'fit' the Simple Algorithm

Data Types
-dates
-alpha-numeric codes
-bit maps and pointers for calendars

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Select Simple but Complete Data Tables and Elements

- Students: class, clinic
- Calendars:
- Academic Calendar: Is session open?
  - days sessions on/off, weekends, summer, holidays
- Assignment Rotation Calendar: Needs for each block session
  - Assignment Code and Description
  - Start and Stop dates;
  - # student/class; need full week or accept partial?
  - # sessions per each rotation
  - # rotations (CPR: once; Emergency: cover all open sessions)
  - total number of sessions required
  - days/sessions students are needed
- Student Calendar: Is student available?
  - each student has own calendar
- Other: 'guaranteed' sessions between assignments

Put everything that might change in a data table.

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Special 'Bitmap' Data Type for Calendars:

-String of 732 characters, where each character represents a date/session

-Day/session pointers for each calendar, stay in sync (same date/session)

-Meaning of values of bit map characters depends on the calendar

-**Academic** - Is the session open?

-**Block** – Is the block open that session? If so, how many students are needed?

-**Student** – Is the student available for that block?

Fits simple 'next session, next day' algorithm

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Academic Calendar: Is the Session Open?

Day/Session legend:
    ON = A/B for Summer session selection;
        Y regular clinic year
    OFF =N for weekends, holidays, other clinic closures

Block Calendars: How Many Students Needed?

Is the block open that session? If so, how many students are needed?

```
                    ORAL SURGERY              DISPLAY BLOCK CALENDARS

START: 8/17/2009 STOP:   4/30/2010      SESSIONS BETWEEN BLOCKS:          6
    MON TUE WED THU FRI                 COVERAGE COUNT? N    # SESS/COVER:  0
     Y   Y   Y   Y   Y                  # SESSIONS:    10    # ROTATIONS:   2
     Y   Y   Y   Y   Y                  SAME WEEK?  Y        TOTAL SESSIONS:
SCHEDULE FOR THE SCHOOL YEAR: # Students  Y=Open  N-Closed
                    1 1 1 1 1 2 2 2 2 3              1 1 1 1 1 2 2 2 2
      1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1        1 3 5 7 9 1 3 5 7 9 1 3 5 7 9
Jl AM NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  Ja AM NNN77777NN77777NNN7777NN77777
   PM NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN     PM NNN77777NN77777NNN7777NN77777
Au AM NNNNNNNNNNNNNNNN77777N77777NN7   Fe AM 77777NN77777NN77777NN77777NN
   PM NNNNNNNNNNNNNNNN77777N77777NN7      PM 77777NN77777NN77777NN77777NN
Se AM 7777NNN7777NN77777NN777NNN777   Mr AM 77777NN777NNNNNNNNNN77777NN7
   PM 7777NNN7777NN77777NN777NNNN777      PM 77777NN777NNNNNNNNNN77777NN7
Oc AM 77NN77777NN77777NN77777NN77777N  Ap AM 77NN77777NN77777NN77777NN7777
   PM 77NN77777NN77777NN77777NN77777N     PM 77NN77777NN77N77NNN7N77NN7777
No AM NNN777NN77777NN77777NN777NNNN7   My AM NNNNNNNNNNNNNNNNNNNNNNNNNNNNN
   PM NNN777NN77777NN77777NN777NNNN7      PM NNNNNNNNNNNNNNNNNNNNNNNNNNNNN
De AM 7777NN77777NN77777NN007NNNNNNN   Jn AM NNNNNNNNNNNNNNNNNNNNNNNNNNNNN
   PM 7777NN77777NN77777NN00NNNNNNNN      PM NNNNNNNNNNNNNNNNNNNNNNNNNNNNN
```

Setup algorithm sets each unique Block Assignment calendar per class
Block Calendar created from:
-Start and Stop dates
-# students needed
-full or partial week?
-# sessions per rotation
-# rotations required
-total sessions required
-days/sessions of need

Algorithm decrements assignment calendar as students are assigned

```
Block Assignmt Code: G                        Student ID:    0
ORAL SURGERY
                    1 1 1 1 1 2 2 2 2 3              1 1 1 1 1 2 2 2 2 3
      1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1        1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Jl AM NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN  Ja AM NNN00000NN00000NNN0000NN00000NN
   PM NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN      PM NNN00000NN00000NNN0000NN00000NN
Au AM NNNNNNNNNNNNNNNN00000N00000NN0   Fe AM 00000NN00000NN00000NN00000NN
   PM NNNNNNNNNNNNNNNN00000N00000NN0      PM 00000NN00000NN00000NN00000NN
Se AM 0000NNN0000NN00000NN000NNN000   Mr AM 00000NN000NNNNNNNNNN00000NN000
   PM 0000NNN0000NN00000NN000NNNN000      PM 00000NN000NNNNNNNNNN00000NN0
Oc AM 00NN00000NN00000NN00000NN00000N  Ap AM 00NN00000NN00000NN00000NN0000
   PM 00NN00000NN00000NN00000NN00000N     PM 00NN00000NN00000NN00000NN0000
No AM NNN000NN00000NN00000NN000NNNN0   My AM NNNNNNNNNNNNNNNNNNNNNNNNNNNNN
   PM NNN000NN00000NN00000NN000NNNN0      PM NNNNNNNNNNNNNNNNNNNNNNNNNNNNN
De AM 0000NN00000NN00000NN000NNNNNNN   Jn AM NNNNNNNNNNNNNNNNNNNNNNNNNNNNN
   PM 0000NN00000NN00000NN00NNNNNNNN      PM NNNNNNNNNNNNNNNNNNNNNNNNNNNNN
```

Day/Session legend:
N = OFF
# represents students still needed to assign to the block
0 indicates session is FULL

Student Calendar: Is Student Available?

> Each student has their own calendar.
> Initial student calendars are created with '.' for each potential clinic session.
> As blocks are booked, calendar is filled with block or clinic-time codes.


```
2/27/2010              UNIVERSITY OF MARYLAND DENTAL SCHOOL      GPC      11:55 AM
                                DISPLAY BLOCK CALENDARS

7████    ████████e                   General Practice Clinic: GP1
Start School Year Date:      7/01/2009            Student Class: S


SCHEDULE: .-ClinicDay ,ClinicAfterBlock Blank-Closed
                 1 1 1 1 1 2 2 2 2 3             1 1 1 1 1 2 2 2 2 3
               1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1  1 3 5 7 9 1 3 5 7 9 1 3 5 7 9 1
Jl AM                                      Ja AM   IIIII  .H,..   ..S.  IIIII
   PM                                         PM   IIIII  .H,..   ....  IIIII
Au AM              PPPPP  PPPPP  .    Fe AM  ,,,.. ....  GGGGG  ,,,.L
   PM              PPPPP  PPPPP  .       PM  ,,,.. ....  GGGGG  ,,,.L
Se AM ,,L.   H,S.  DDDDD   ,,,.   III Mr AM  ,.... ..I          AAAAA  AAA
   PM ,,L.   H,,.  DDDDD   ,,.    III    PM  ,.... ..I          AAAAA  AAA
Oc AM II  ,,,,.   ...L,  GGGGG  ,,,.. Ap AM AA  ,,,.-  ..L,.  IIIII  ,,,S.
   PM II  ,,,H.  .K,L,  GGGGG  ,,,.-     PM AA  ,,,,.  .. ..  I II  ,,,,-
No AM    I,.  ....  EEEEE  ,,I    ,   My AM
   PM    I,.  ....  EEEEE  ,,I    ,      PM
De AM ,,,.  ..L,.  ....  I,.          Jn AM
   PM ,,,.  ..L,.  ....  I,              PM
```

> **Block Codes:** 'Letter code' *represents Block Assignment. (G=Oral Surgery)*
> **Clinic-time Codes:** ',' /Comma *represents 'guaranteed' clinic session between assignments.*
> '.' /Period *represents regular clinic session that could be a block assignment*

Pointers keep Block and Student Calendars in Sync

Academic Calendar

Pointers to each calendar points to the same day/session

Many simple data manipulation routines

Block list:
-add/change/delete block; update block parameters
Student list:
-add/change/delete student
-get student from 'next' clinic
-get next student
Academic calendar:
-Check if clinic is open
Block calendars:
-fill block
-are all blocks covered?
Student calendars:
-Check student availability
-set student to block
-are all students booked?
-summarize number of students per clinic per block (QA)
-summarize number of blocks per student (QA)
All calendars:
-convert 732 character sequence to monthly display
-display 1 calendar (any type)
-create initial calendars from parameters
-support individual calendar adjustment

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Repetitive Block Scheduling Process

After academic, block and student calendars are entered and verified:
-scheduler program is run discretely for each rotation of each block.
-this allows access to the schedule developed thus far
-to look for scheduling problems at their earliest conflict.

Problems found can be resolved by:
-modifying a few students schedules or
-clearing and restarting the block assignment

Based on policy, the algorithm can select the next student:
-from the same clinic or
-another clinic

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Continuous use of the same data driven block algorithm through major operational changes:

1994   Original version meets the needs of:
8 clinics, 1 floor, >10 blocks per class
'evenly distributed student assign by clinic'
2000 Y2K upgrade
2002   Compact clinics from 8 to 4 clinics
2003   Move to new Clinic Information System;
Added export, import process
2004 Increase class size by 20 students
2006   Move to new Dental School:
4 clinics, 2 floors, added evening clinic
2006 Change to 'student pull from 1 clinic' approach
2007 Return to 'evenly distributed assign by clinic'

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Conclusion:

Use of a data driven approach has continued to be successful after 15 years, multiple clinic reorganizations, changing student rotation schemes, expansion of our student body as well as a move to our new Dental School.

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Questions & Comments?

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