


Automating Treatment Planning Workflow with Scripts

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Disclosures

- I am a cofounder, officer, and employee of Radformation, Inc.

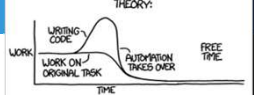


About me

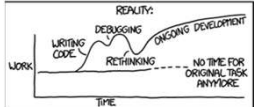
- ABR certified medical physicist
- I love programming
- Cofounded Radformation because

"I SPEND A LOT OF TIME ON THIS TASK. I SHOULD WRITE A PROGRAM AUTOMATING IT!"


THEORY:




REALITY:



https://xkcd.com/1319/




Automation: A Logic Puzzle





- Identify the task *Understand it fully*
- Identify available tools *Can you build the missing pieces?*
- Implement the solution *Usually iteratively*

- IMPORTANT:** One of the greatest barriers to automation is **unclear or inconsistent expectations**
 - e.g. can your team commit to using specific templates (structure IDs, dose constraints, etc)?




Identify Available Tools - The API

- Scripting Application Programming Interfaces (APIs)
 - Access product functionality directly
 - Tight integration (efficiency)
 - Very powerful & flexible
 - BUT possible limitations requiring workarounds

Scripting

- Enormous power and flexibility
- ... but much higher barrier to entry
 - Learning to program?**
 - Like learning a new language, can be very frustrating
 - ... but also very rewarding
 - Lot's of great resources to help you learn...
 - If you can muster the **motivation, time, and energy**
 - You will **definitely** encounter barriers
 - A project that motivates helps **a lot**
 - General Advice: **Divide and Conquer**
 - Break a task down into well-defined manageable units
 - Explore the API & experiment



Varian Developer Community:

<https://github.com/VarianAPIs> : Example projects are **extremely** helpful

Explore the API

- Dig through to see what's available (**and what's not!**)
- Play with Visual Studio Intellisense
 - How do you get from your ScriptContext to your Image data?
 - How is the Image data presented?
 - Eclipse API is fairly low-level in some things
 - Getting image data into an easily displayed format takes some work
 - **Experiment with it** e.g. Can you draw a CT slice from data pulled through the API?
 - Other things are higher level (e.g. optimization, dose calculation functions) and easier to use

Script example - ClearCheck Live Demo

- ClearCheck Task:
 - Plan Analysis & Plan Report (TG-275 & TG-315-draft)
 - Check Dose Constraints
 - Check Plan Parameters
 - Check Structures for Errors
 - Check for Collisions
 - Print Complete Plan Report
- Tools / Implementation:
 - Varian Eclipse™ API: Read plan data
 - Programmed Analysis and Report Generation
 - **Make it easy to configure templates**

ClearCheck Constraint Check Results

- Manual Constraint Reporting:
 - 2% had >1% error
 - 0.8% had >10% error
- ClearCheck Constraint Reporting:
 - 0 errors
 - Large decrease in time for definition, evaluation, and documentation of constraints

Burnmeister, J.W. et al. Implementation of an Automation Tool for Treatment Planning Constraint Designation and Plan Evaluation. *International Journal of Radiation Oncology • Biology • Physics*, Volume 102, Issue 3, e534 – e535

% Deviation	Number
<-1	812
-1-3	11
4-6	5
7-9	6
10-20	1
>20	6

Treatment Site	Automated	Manual	Time Savings
HeadNeck	1.9	4.6	2.7
Lung	1.8	6.1	2.3
Surg SBRT	2.3	8.5	6.3
Stomach	2.5	4.2	1.6
SoftTissue	1.6	6.2	4.6
Pancreas	1.9	4.6	2.7
Prostate/GYN	3.9	9.6	6.3
Anal Ca	2.0	6.5	4.5

Script example - EZFluence Live Demo

- Task:
 - Automate 3D Conformal Planning (Field-in-Field or Electronic Compensator)
 - Breast
 - 4-Field Lung
 - Whole Brain
 - etc.
- Tools / Implementation:
 - Varian Eclipse™ API: Read plan data, write back new plan data
 - Optimization algorithm exploration and experimentation

EZFluence Results

- Average of 85% reduction in planning time
 - Average of 3.7 minutes for EZFluence
- Overall comparable or improved dosimetry (v1.1)
 - Lower V105% on larger breast patients

UC San Diego

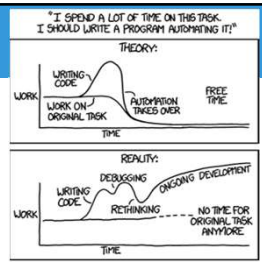
(15 patients)	D95	V105
Manual	93.5%	137cc
EZFluence	96.2%	73cc

Yoder, T., Hsu, A. T., Xu, Z., Stenski, A., & Byju, S. (2019). Usefulness of EZFluence software for radiotherapy planning of breast cancer treatment. *Medical Dosimetry*, 1-5. doi:10.1016/j.meddos.2018.12.001

Dragovic, B. J., Hancock, R., Mangan, J. Assessing the Performance of Automated Breast Treatment Planning Software. AAPM 2019 Poster.

DIY Scripting Pitfalls

- Verification and Validation (**Safety**)
 - How can you be sure it works correctly & meets the end-user's needs?
- Long-term Support
 - What happens if the developer leaves?
 - Will the tool break when software versions change?
- Department Buy-in



RAD formation

Summary

- Scripting is extremely powerful and has the **potential** to increase **efficiency**, **quality**, and **safety**
- You have the power!... it just takes:
 - Time
 - Energy
 - Department buy-in

RAD formation