MATH *IS* GOOD FOR YOU

"Algorithms" has become an everyday word. We use them to find our way to a restaurant or play Minecraft on our phones.

We also use these instructions for performing calculations to cure cancer.

Doctors use MRIs and CT — short for computed tomography — scans to get a picture of tumors before applying radiation. These medical imaging methods depend on algorithms and the mathematics behind them.

Math Professor Dana Paquin and her students are teaming up with Stanford Medical Center to make the way these scans are processed more accurate so that radiation treatments can be more exact.

When treating a tumor with radiation, the goal is to maximize the radiation dose received by the tumor while minimizing the exposure of healthy tissue to radiation. To achieve this goal, doctors use a process called segmentation to separate the image into parts and find the edges of the tumor.

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>
> — PROFESSOR DANA PAQUIN

"We're developing automatic segmentation algorithms that are more precise than current methods, which are mostly manual," said Paquin.

Because large amounts of x-ray radiation can be harmful to people, CT scans require a balance of enough x-rays to accurately see the position of an abnormality, such as a tumor, and little enough radiation to not harm the patient. A lower amount of radiation can lead to noise in the image. Noise is random imperfections produced by the process of recording an image, like the graininess in a photo taken in low light — there isn't enough input to make the picture sharp.

The problem with noise in a CT-scan image is that it's important to know where the edges of a tumor are.

As part of the Frost Summer Undergraduate Research Program, students Brady Berg, Conor Carroll, Weston Grewe, Brian Knight and Tuyen Pham worked on developing algorithms to achieve high-quality segmentation of noisy images. The student research team developed and analyzed computer code using programming languages Python and C++ to implement their segmentation algorithms. Their code is being evaluated and tested using medical images from the Stanford University Medical Center.

"This project gives students the opportunity to engage in a meaningful, hands-on way with applied mathematics in a realistic setting," Paquin said. "They get to see the power that mathematical analysis has in creating change."

That change has the potential to improve the lives of cancer patients everywhere, all thanks to some not-so-simple mathematics. //

Pictured: (clockwise) *Student Brian Knight, Professor Dana Paquin and students Brady Berg, Conor Carroll and Tuyen Pham work on developing algorithms to process MRI and CT scans more accurately. Knight works on equations that form the basis of the algorithms.* ***Photographer:*** *Desiree Gillaspy (Graphic Communication, '18)*