Problem Set 6

(Out Wed 03/30/2020, Due Wed 04/08/2020)

Problem 8

The fire control of New South Wales would like to test a new approach to impede the propagation of bush fires: In a checkerboard pattern, regular squares of $1\,\text{km} \times 1\,\text{km}$ are treated so that the propagation speed of the fire front is slowed down.

a) Write a program that simulates the advance of a fire front that starts in the center of an untreated square and moves outward in its normal direction, with a velocity that is $1\,\text{km/h}$ in the untreated squares, and $\varepsilon\,\text{km/h}$ in the sprayed squares.

b) Create a function $d(\varepsilon)$, where d denotes the largest distance of the fire from the origin at the final time $T_{\text{final}} = 24\,\text{h}$. Do so by running your simulation for a whole range of values $\varepsilon \in [\frac{1}{100}, 1]$. Also plot the shape of the burning region for $\varepsilon \in \{\frac{1}{100}, \frac{1}{3}, \frac{4}{5}, 1\}$.

c) Explain your results: Are there any critical values of ε at which a transition in the fire shape occurs? Is the idea of a checkerboard spraying a good one?