Project Proposal: CSE 6730 Project 2

Chris Dunlap, Allen Koh, Matt May

Spring 2016

Contents

1 Proposal

In the United States, the National Aeronautics and Space Administration (NASA) has announced its plan to send humans to Mars during the 2030s. This ambitious goal requires a variety of studies be conducted to effectively plan the endeavor. General habitation, food production, resource extraction, communication, spacecraft, and many other areas must be studied to determine their optimal configuration.

For our second project, we propose a simulation of population growth dynamics on Mars, with the goal of determining an optimal strategy for sustainable population growth. Population growth models have been extensively studied in the literature [4], [3], [6], [2], [5] but generally only in the context of our own planet. Often, natural populations without resource limitations exhibit exponential growth [1]. However, this type of rapid growth will likely be unsustainable under the extreme resource constraints of Mars. By considering several proposed habitation models for Mars, we hope to better understand the resource requirements of these approaches, and by that develop recommendations for sustainable growth.

More specifically, we intend to model humans as consumer entities, and several types of resources such as food, water, and sanitation availability as resource entities. We intend to take a stochastic, discrete-time approach. As David Quammen notes [7], there are four sources of uncertainty to which a population may be subject: demographic, environmental, natural catastrophes, and genetic. We will attempt to model several of these to provide the greatest realism possible.

From a programming perspective, we plan to use Scala, a hybrid object-oriented/functional programming language that runs on the Java virtual machine (JVM). Scala is performant, relatively terse, statically typed, and interoperable with Java, making it an excellent choice for developing our simulation.

References

[1] Teresa Audesirk, Gerald Audesirk, and Bruce E Byers. *Biology: life on earth*. Prentice Hall, 1996.

[2] Ester Boserup, N Makhoul, RE Munn, TN Srinivasan, JA Robinson, and C Rocha. Population and technological change: A study of long-term trends. *International Journal of Health Services*, 13(1):15–31, 1983.

[3] Hal Caswell. *Matrix population models*. Wiley Online Library, 2001.

[4] Colin Clark et al. *Population growth and land use*. London: MacMillan., 1967.

[5] Paul R Ehrlich, John P Holdren, et al. Impact of population growth. *Science*, 171(3977):1212–1217, 1971.

[6] Donella H Meadows, Dennis L Meadows, Jørgen Randers, et al. *Beyond the limits: global collapse or a sustainable future.* Earthscan Publications Ltd., 1992.

[7] David Quammen. The song of the dodo: island biogeography in an age of extinction. *Hutchinson, London*, 1996.