Project 0 – Bad Ash's Army

In *Army of Darkness*, Bad Ash and his army of skeleton warriors return to life to battle humanity for control of Medieval England. Unfortunately, all the skeleton soldiers are buried underground and must be unearthed before they can join the fight. Our goal is to figure out how quickly this army will grow.

In solving this problem, we first assume that reanimated skeletons never tire, never eat, and never sleep; thus, once a skeleton is dug up, it can immediately start digging out comrades and will continue to do so indefinitely. For ease of computation we additionally assume that all skeletons have immediate access to shovels and that a single skeleton is able to dig a hole in 32 minutes. Identification of these assumptions allows us to focus our attention on one parameter; the size of the teams working to dig holes. Given a pre-determined digging team size, our model returns the size of the army at any time after digging begins, allowing us to find the most efficient way to grow the skeleton army.

As previously stated, our model allows us to choose the size of the team, which we will denote as N. Since it takes N skeletons working together 32/N minutes to dig a hole; we increase the army size by a number of skeletons equal to current number of digging teams at each 32/N minute interval. Fractional skeletons are counted as part of the army, but are not counted when computing the new holes dug in the current round of 32/N minutes.

Team Size\Time	**128 minutes** (~2.1 hours)	**256 minutes** (~4.3 hours)	**384 minutes** (~6.4 hours)	**512 minutes** (~8.5 hours)	**640 minutes** (~10.7 hours)
1 Digger	16	256	4,096	65,536	1,048,576
2 Diggers	21	533	13,655	349,956	8,968,992
3 Diggers	22	690	21,776	687,461	21,702,655
8 Diggers	28.62500	1,220	52,866	2,292,163	99,297,128
16 Diggers	29.43750	1,403	67,940	3,289,834	159,303,755
24 Diggers	30.08333	1,493	75,146	3,783,259	190,470,488
32 Diggers	30.28125	1,532	78,678	4,040,533	207,503,647
40 Diggers	30.3	1,548	80,473	4,182,773	217,411,643

Table 1 *Size of Ash's Army at various times, based on a set number of workers in each digging team.*

Our model displays the powerful growth rate inherent in exponential growth. It also emphasizes the value of having skeletons collaborate, as army size increases more rapidly with bigger teams. However, these improvements become less dramatic as team size increases. This is an expected result, since we know from calculus that such models tend to approach a limit related to the exponential function, e^x.

This model might be made more accurate if a team size threshold was determined so that once the line is crossed productivity begins to decrease. For example, fifty skeletons could not (conveniently) work together on the same hole, so increasing team size should eventually result in diminishing returns. We also believe that our initial assumption of unlimited shovels is unreasonable and most likely would lead to digging teams that are not fixed in size. Additionally, our initial assumption of 32 minutes to dig a hole could most likely be improved with some further research.