

Orbital Underwriting

Fifteen years ago: Jack ducked his head under the surface of the water every few minutes to combat the heat and acrid air. The house on the other side of the pool had been burning for two hours and it looked like it was only halfway done. He had two things going for him: 1) everything nearby other than the house had already burned as the front of the wildfire had moved on from the neighborhood, and 2) he had quickly thrown some pool furniture into the water as he arrived and, after stacking it, he was neither treading water nor trying to hold onto the side of the pool. He could stay almost entirely immersed in water other than to breathe.

At least he had run for the neighbor's pool instead of the nearby creek. Although he didn't previously know the state of either location, the creek was not very wide or deep, had trees all around it, and any other wildlife also would be running for that water. Fortunately, the neighbor didn't have an active defense where the pool would be emptied into a sprinkler system to spray on or around the house. "It takes forever for a house to burn down", he found himself saying to the wind. At least his parents had been out of town, so while they all later returned to a burned-down house and lost everything, no one in the family had been injured or killed while the rest of the neighborhood was devastated. Jack at age 14 wasn't able to evacuate on foot and hadn't known to leave until it was already far too late to evacuate.

Current Day: Jack just completed all the actuarial exams and started practicing, working for Orbital. The mission statement makes it perfectly clear what Orbital is trying to do:

Underwrite the wildfire risk for an individual homeowner using a satellite photo and artificial intelligence (AI) scoring the property without human intervention.

Jack had been hired to complete the underwriting proof-of-concept for the company so it could ask investors for more venture capital money.

CEO: "The satellite technology seems to be there to provide enough photo resolution. The AI isn't trained yet, but we have pictures of 1,000 sample properties and that should be enough to train the AI to read the photos and score the properties. The cost of a satellite photos keeps decreasing and the resolution keeps increasing, so we want to jump on this opportunity before everyone else does the same thing. We think that with an AI reading/scoring the property we have a competitive advantage. I'm just glad we didn't have to call the drone people for flyover photos, which would have been a lot more expensive and less reliable. We want the AI trained and ready for production in a month. We need the proof-of-concept completed in a week."

Jack: "How do you want me to proceed to train the AI?"

CEO: "The AI already has all the defensible space rules to read the satellite photos of 1,000 properties and score them from 0-3 with 3 as the best risk and 0 as an uninsurable risk. The first round of AI scoring will be done tomorrow. We want an expert, Emily Liu, to check the AI and adjust it where needed. She is the premier US expert on wildfires and has given speeches, written papers, and made videos all about wildfires. You will work with her on improving the AI to make it ready for primetime. Once we have the adjustments, we will feed the AI 5,000 properties and see if we have something usable. She'll be here in two days, staying for three days, or possibly slightly longer. She has a very crowded schedule and must attend a conference to attend so we can't miss this window."

Jack: "I've heard of her from some interviews on mitigating wildfire risk. I'll take a look at the AI results as soon as they are ready and work with her to make the AI as accurate as possible. I know we want to sell an underwriting service, so this needs to work."

CEO: "...and we need venture capital money to keep going. Times are tough for insure-tech startups right now and Orbital is no different than any of the rest."

Jack left and pondered this proof-of-concept project. No one at Orbital knew he had survived a wildfire 15 years ago that went through a neighborhood he later learned was a Wildland-Urban Interface (WUI) area that should have had defensible space around any houses or structures. He had made an extensive study of wildfires and defending against wildfires. "It will be interesting to finally speak to an expert on wildfires – I have so many questions" he said to the corporate-owned oil painting of a prairie fire hanging on the wall. While waiting on the AI preliminary results he brushed up on defensible space.

The next day Jack pored over the scores for the properties. The AI scores the property down to the first decimal then rounds to an integer 0-3. Jack reviewed a sample of the properties in each risk category. "You seem to be scoring based on the distance of the nearest tree branch from the house. Nothing in the best risk category has any tree branch closer than 35 feet from the house. Nothing in the worst risk category has a nearest tree branch further than 35 feet from the house, and usually multiple trees encroach. What are you thinking?" he said to the screen, realizing just then the AI doesn't completely "think" anything.

Emily arrived the next day and Jack pulled up the results on a monitor for her to view. Jack was intrigued with the thoughts of the wildfire expert grading the AI.

Emily: "It is probably best if I take a look at the AI results for a couple of hours and then we should meet to talk about what the AI is doing. As you may know in many parts of the country people call a professional for an assessment and the result of that assessment turns into a plan for the homeowner to mitigate the wildfire risk. Here we are trying to perform many of the aspects of that assessment from a single satellite photo. It is a big ask."

Jack: "I looked at results yesterday and it seemed like the AI was basing a lot of the score on the nearest tree branch from the house, like it is basing most of the score on the risk from a crown fire."

Emily: "It sounds like you know something about the three different types of wildfires. The crown fire gets all the press rolling along at up to 2,000 degrees Fahrenheit with high winds and burns nearly everything. The surface fire looks similar to what happens after a lightning strike where all the ground level plants burn and reach the house. The ember storm is many embers thrown by a wildfire carried by high winds and where enough land, accumulate and continue to burn long enough the house burns down, as much as 90% of the property loss from a wildfire is from an ember storm."

Jack: "I survived what I later realized was a crown fire in a neighbor's pool when I was 14, so I had some motivation to understand what happened and how to mitigate the risk. The neighborhood was devastated. It was rebuilt, but it was a couple of unstable years for the neighborhood and for me."

Emily: "Sorry, you lost your house and all you had to endure. I never suffered a direct loss. In a public life full of appearances, speaking, writing, video creation, I encounter many people recounting harrowing

experiences. I do everything I can to communicate to people to take the risk seriously and mitigate it as much as possible. I bet it took forever for the neighbor's house to burn down."

Jack nodded, as it certainly did.

Two hours later they reconvened.

Emily: "The AI explained its score for each photo with enough information to understand most of what it is doing. Someone provided it all the defensible space rules and heuristics and asked it to pick a score based on everything it knew. The problem is if I were doing an assessment, I would stress with the homeowner a few critical items that must be done first and are more important than others. Also, look at the best score. See anything wrong here?"

Jack: "It looks like a lunar landscape with nothing around the house other than rocks and dust for 200 feet."

Emily: "We have to make sure the AI likes trees, or it will push underwriting in the direction of removing all the trees on a property to minimize the risk to the house. In addition, the AI needs to switch between the defensible space rules for inside a Wildland-Urban Interface (WUI) and outside a WUI. It seems to be using the same defensible space rules everywhere and it is scoring nearly all properties outside the WUI as close to zero or uninsurable."

Jack: "It feels like the nearest tree branch at 35 feet from the house is way too close if a crown fire is 2,000 degrees Fahrenheit. We are trying to keep the house below about 350 degrees Fahrenheit to prevent it from burning, that doesn't seem to be enough distance. There is no way a person without protective clothing and equipment could defend the house in that situation."

Emily: "You've instinctively found the two weak spots of defensible space. If we told people how far away the trees really had to be, they would comply even less than the small percentage that fully follow defensible space rules now. For trees that are large at maturity, to keep the nearest tree branch 35 feet away you would have to plant no closer than about 70 ft away. And that is 70 ft that can't be closer to the neighbor's house either. The average yard is about 100 ft in any direction measuring from the outer edge of the house roof. A homeowner fully complying with the current defensible space rules would be lucky to have room for a large tree in the front yard, a couple of large trees in the back yard, and no trees in the side yards between houses. Even that puts the 2,000-degree wall of flame close to the house. It may be low enough to not burn the house down if the wind is not too high heating up the entire area where the crown fire is, but nowhere near low enough for a person to stand outside and defend the house even with protective clothing. We want everyone to evacuate as there is a high prioritization on lifesaving over property saving. And that is just the crown fire."

Jack: "Right, 90% of the lost structures are from ember storm. Even if the crown fire is held away from the house, it will spit embers continuously toward the house in an attempt to burn it, potentially in 50+ mile per hour winds. Like it is a dragon forced to spit fire from a stand-off distance."

Emily: "Wildfires are sometimes compared to the Western dragon, mostly because dragons go wherever they want, potentially burn anything in the way, spray fire and sometimes randomly skip houses just as temperamental a dragon is considered to be. It is anthropomorphizing, but not entirely inaccurate. When you live through one, a wildfire can feel like it is alive. The Western dragon has to be controlled or it will

kill nearly everything. Kill the dragon or the dragon kills you. The Eastern dragon is mystical and festive and rarely if ever causes harm. Whenever someone mentions dragons, I have to remember they are talking about their version of a dragon.”

Jack: “How far away from the house do the trees need to be to keep cool enough for someone to stand outside and defend it against a crown fire?”

Emily: “I’m not even sure it could be done with our best scoring lunar landscape property. With high enough winds carrying the crown fire heat like it is a convection oven, it may not be possible to stand in front of the house and survive at any distance under 200 ft. The advice is always to evacuate early. A person can stand and defend the house against an ember storm as long as it is carried from a far enough distance away. Embers were carried by winds up to 50 miles away in the 2022 Australian wildfires. For a surface fire it depends on how it started and is continuing. If it is surface fires from a distant source a person may be able to defend, if from a close source, everyone needs to evacuate. If there are embers blown 50 miles, it means the distinction between inside and outside a WUI becomes blurry.”

Jack: “How do we adjust the AI to be more realistic in assigning a risk category? We only have three days with you here to help train the AI completely.”

Emily: “The first thing the AI needs to know is whether the property is in the WUI or outside the WUI as different defensible space rules apply. No one has defined what defensible space rules should be outside of the WUI. We might consider using the “home ignition zone” in the defensible space rules of the first five feet around the house where nothing flammable should be. Further we might give a higher score when trees appear to have been planted with a trunk no closer than 16 ft from the house. Anyone with any common sense will push their trees at least that far away. There are no current state laws about minimum planting distance from a house or about maintaining the first five feet as nonflammable to help start to protect houses outside the WUI. The 16 ft helps limit any potential foundation damage from tree roots and gives any fire crews room to operate on any standard structural fire that may occur.”

Jack: “Wildfire doesn’t know it is supposed to stay in the WUI where there may have been more preparation. If the embers can be carried for 50 miles and well outside any defined WUI, it would be good to have some level of defensible space outside the WUI. The probability there may be lower, though a wildfire still could happen in those areas.”

Emily: “We are a little ahead of the curve here as defensible space rules are not discussed for areas outside the WUI and there is no consensus on what to use. It might be better to start somewhere rather than just continuing to do nothing. Too much housing loss is at stake if a wildfire jumps outside the WUI. We are making up defensible space rules for outside the WUI, but if Orbital can explain to the insurance companies what it is doing and how it is scoring the property, it may be a forward-looking result. People expect that kind of value-add from an insure-tech.”

Jack: “How do we make sure the AI likes trees?”

Emily: “We have to not let the AI give a higher score for a lunar landscape, that’s for sure. Some jurisdictions require a homeowner to maintain at least two trees on a single residence property, almost no matter how small the property. Perhaps we tell it to score the maximum if there are only trees at defensible space distance and deduct if there are no trees. That should avoid pushing homeowners

toward removing all the trees. We just want no trees where they can increase the frequency and severity of damage to houses, rather than no trees at all on the property.”

Jack: “I watched some of the videos where you were walking a property and giving the homeowner advice. You kept saying it was the little things that people don’t do that can void all the protection of the defensible space and burn down the house in a wildfire. The little things are things like leaf clutter on the roof or gutter or next to the house where the wind carried it as that is where the embers will land and find a good fuel source, the flammable broom, mat, and furniture on the porch, and the dead parts of plants not removed near the house. Then there were more technical issues, like open eaves or eaves without the right fine mesh, not the best fire rating on the roofing or walls, firewood or other fuel stored too close to the house, and wooden fences and wooden decks that come right up to the house. Can the AI really distinguish all of these items from one satellite photograph?”

Emily: “You have done some research. A satellite photo can only see what it can see from above. It can’t see the mesh over the venting on the eaves or underneath the porch to see the broom, mat and furniture. It just can’t see anything under anything. It has a chance to see a wooden fence or wooden deck up against the house, either of which should knock the property out of the best risk category. It can see any fuel piles on the property as long as they are not under some part of the house or right up against a house. I don’t think it could distinguish roofing or siding with a good fire rating compared to a poor fire rating. It can’t see if the trees have been limbed up or clear underneath to avoid a fuel ladder. The homeowner will have to provide supplemental information for the items that can’t be seen in the photo. If you have watched my videos, then you know...”

Jack: “...mitigation efforts start closest to the house and work outward. The home ignition zone is the most important. The first five feet must be maintained as nonflammable so any embers burn out before they can accumulate into starting the house on fire. I was really impressed that you would do the assessment and tell the homeowner what they needed to do in priority order and then you would return later after the homeowner had completed mitigation efforts.”

Emily: “Thanks, we try to make the videos as informative and accessible as possible. We want homeowners to build that full defensible space so that even if there are more frequent and severe wildfires, whether due to climate risk or any other factors, more houses are saved. It is still common to go into an area after a wildfire where less than 1 in 20 houses are still standing, where homeowners didn’t take the wildfire risk seriously enough. In many cases, if the homeowner had mitigated the worst remaining risk and kept moving down their priority list, they may have done enough to save their house when the wildfire went through the area. They are never sure until they return after the wildfire to see whether their house is still standing intact.”

Jack: “I have been curious about one other fire risk. Aren’t sky lanterns, the ones that people light and release into the sky, a fire risk? Is it really a good idea to float an open flame into the sky where it could fall to the ground before the fuel burns out?”

Emily: “There are plenty of cases where a sky lantern has started a fire that caused extensive damage. Some states ban them entirely or ban them unless they are tethered to the ground. People launching them don’t pay attention to weather conditions, thinking these will all safely burn out before landing on a fuel source and start a fire. Launching anything into the sky on an uncontrolled flight with an unknown landing area is littering. Sky lanterns are analogous to helium balloon releases, where no one pays any

attention to where the balloon pieces, semi-intact balloons, and any strings and plastic stoppers land, and the damage they do to wildlife in addition to littering. Neither anything from a sky lantern or a helium-filled balloon is truly biodegradable and certainly doesn't degrade in time to avoid harm to wildlife."

Jack: "Thanks for confirming what I thought."

Jack noticed it was already afternoon and they still had a lot to do to adjust the AI and set it up to revise scores for the next day.

Jack: "We've been thinking about how to better train the AI for over half the day, so I think we should provide the AI with everything we have just discussed and then give it a chance to revise scores for tomorrow. We want it to keep the scores for any prior version when it determines a new score. This way we can track it as the AI keeps improving. We should cycle the AI at least daily. By the third day, I am hoping we are at least starting to have the AI read the 5,000 photos even if it has not completed it by the end of that day."

Over the next two days, they continued refining the AI until they were satisfied with the resulting scores. They kicked off the larger run and waited for it to finish.

CEO: "Is the AI ready?"

Jack: "We've adjusted the AI as much as it needed, and we are running the larger set through now."

CEO: "It sounds like we have completed the proof-of-concept. Good that we have something to show potential investors so they can provide us some much-needed capital to continue into production. Thanks for all your efforts, Jack, and Emily."

Emily left at the end of the day and went to a National WUI Conference where she was presenting.

After Jack left for the day, he found a tree where the trunk had no branches for the first four feet up from the ground, a classic sit-under tree. Sitting while leaning against the trunk pondering life a while, he said to nowhere in particular, "If everyone followed the defensible space rules, even if for no reason other than to pay a little less homeowner's insurance premium, would more houses be saved from wildfires? Will the Orbital underwriting process decrease the overall number of trees? If the trees removed are so close to the house as to be a wildfire risk, is that a good outcome?"