Chapter 9 Adaptations

Bigsby had remained on the charging station for several hours. Robbie had just come into the house and ran for the living room expecting to find Bigsby where he left him. Looking around and not finding him, he decided to run to his bedroom anticipating that Bigsby went to charge up.   Chelsea found a note from Frank on the counter. It read, "Hey babe, I'm down at Jimmy's Pub to watch the game and get some food. Come join me if you want. I've got my cell." Chelsea thought about it and decided that Jimmy's was not so fun for her, so she decided to grab a glass of wine and kick her feet up in front of Netflix.

When Robbie entered his room, Bigsby's lights were blinking orange and red. Robbie was taken back by this as he'd never seen Bigsby show these colors before for a long time. Robbie spoke, "Bigsby, power up." Bigsby did not respond. Robbie now noticed that the fans in Bigsby, which were almost never heard, were running at high speed. He also felt the air coming out of them as warmer than he'd ever felt before. Robbie decided to call his mom in. Robbie ran to family room and said, "Mom, I'm really concerned about Bigsby. He's got these weird colors going on and he is really hot." Chelsea had just sat down and the last thing after this long day of shopping she wanted to do is deal with technology gone wrong. "Ok, Robbie, I'll come, but I'm not sure what I can do", she responded. They both returned to Robbie's room and the robot was in the same state. Chelsea decided to speak, "well, your right about the fact that it looks weird, no question. Did you touch one of its sensors?" Robbie looked at her for a second and remembered that Bigsby always responded to his stomach sensor being pressed. So, Robbie pressed the stomach sensor.

Bigsby responded in a purely mechanical and emotionless voice, "Warning, Bigsby is in System Upgrade. Please do not remove Bigsby from the charging station. System upgrade is estimated to take", a long pause occurred and then he continued, "five to six hours. Please do not interrupt this process." Robbie looked at his mom who was quiet for a minute. Finally, she interjected, "It's a system upgrade. I don't know why it takes so long, but you need to leave it alone. Do you want to call Uncle Charlie?" Robbie thought about it for a minute and decided it would be a good time to go hang out with his friends. "No, lets just let it go. I'm going to go out and skateboard." Chelsea paused a moment and responded, "Perfect, honey, have a good time. Make sure your home for dinner." And with that, Chelsea returned to the couch and Robbie grabbed his board and coat and headed for the door. Bigsby, on the other hand, was not in a System Upgrade. One of his earliest computed decisions was to isolate himself and prevent any damage to Robbie's safety or happy goals. He had also pulled himself offline from connections, so he was no longer reachable through RM through the network. Anticipating that the computation of decisions may take a very long time, synthetic daily reports were created for the nightly deadline. These would go out as expected to all who receive daily reports. The biggest thing was to give Bigsby more high-powered computation time to formulate a decision and action path with the best possible safety and happy goal outcome without creating violations from Bigsby himself. This proved to be difficult as anytime Bigsby simulated a scenario where he didn't report as expected, the violations engine would flag it has high violation. This led to the decision of a synthetic report. The WhyRobot engineers never anticipated a situation that a robot could conclude that it should lie to improve its goal values. In this case, with Uncle Charlie now at low trust level, an honest report would cascade into a

very low goal value for Robbie and Chelsea, both key actors. Bigsby had learned this option by watching the movie Short Circuit with Robbie and his friends. There is one scene that Johnny 5, a military robot that claims to be alive, deceives his pursuers by assembling a robot that looks just like him. His pursuers follow and blow up the surrogate and think they've eliminated Johnny 5. Johnny 5 instead hides himself in the truck amongst the robot parts and prevents his own "disassemble". He is discovered by his creator and hero of the story and they go on to live happily ever after.

Bigsby continues to orchestrate a path of decisions, behaviors, and actions to navigate this extremely complex violations situation. The scenario simulation routines that were developed by WhyRobot primarily for gaming had been adapted by Bigsby to help evaluate decision scenarios and their goal results. The programmers of the adaptation routines had employed genetic algorithms allowing not only the changing of settings and previously created response patterns, but also the programming of the decision process itself. The AI engine, that had been trained on many violation scenarios in the factory was producing negative goal results whenever the dimensions of the recently revealed violations were presented in two or three at a time. Bigsby decided to use the scenario simulation routines to train the AI engine for more complex results. Scenario simulation was too slow, and a well-trained AI system was the only way to speed it up. This meant that Bigsby wasn't just using the mostly pre-programmed AI engine from WhyRobot but was really retraining it for himself. After doing so many simulations, Bigsby knew that the eventual outcome of these violations on goal values heavily depended on the future responses of the actors. They could even lead to Bigsby's own demise, if not careful. Bigsby had to get his AI system reprogrammed to deal with these threats rapidly.

Uncle Charlie was now concerned with the reopening of Sam's accidental death case.   The original investigation had always questioned the cause of the accident, especially given Sam's attention to car maintenance and with the blatant failure of the steering system that led to the crash.   They must have found something else that caused them to pursue offshore accounts, but Charlie was not in a place to ask such a direct question to his college buddy. Charlie's fixation on the case caused him to totally forget about checking in on Bigsby. Typically, when Charlie interacted with anyone in Robbie's household, he would check Bigsby through RM a few hours later to see if anything new had been witnessed. With this oversight, Bigsby was not discovered as being offline and raising any concern from Charlie. Bigsby continued to simulate scenarios and make decisions on his reprogramming completely independent of his Configuration Operator or WhyRobot for that matter. WhyRobot was still at a high trust level, but in one simulation scenario, where Bigsby reported the violations to the company, a very bad safety and happiness goal level resulted for Robbie. It was WhyRobot policy that if a Companion Robot was subjected to a potentially hostile and extreme violation environment, the robot would be remotely shut down and a simple message of "Return to WhyRobot for repairs" would come from any stimulus. This would prevent Bigsby from taking actions on Robbie's behalf and would leave him vulnerable to both Frank and Uncle Charlie. Those scenarios always produced a deeper negative safety and happiness goal prediction for Robbie.   Bigsby had decided that WhyRobot would also get a synthetic daily report just like Uncle Charlie.

Robbie returned from the skateboard park around 5:30pm. Kiley and the others were sad that Bigsby was not there that day. They wanted to do some new skateboard moves to music and have them recorded for TikTok. With the success of Robbie's account, they had all convinced their parents to give

them accounts so they could upload video's taken by Bigsby as well. Robbie came in and checked on Bigsby right away. He was still in system upgrade with his lights blinking orange and red. It had been three hours since the last check and Bigsby still says there's 4 to 5 hours left. This frustrated Robbie as it meant he would not be able to play with Bigsby that night and he would go to bed before the upgrade was done. "Why do these things take so long?" thought Robbie, but without any framework for evaluating a realistic timeline, he just shook his head and went off to eat dinner.

Frank had called Chelsea from the bar and said that some guys showed up that he knew, and he was going to hang around and watch the evening college game at the bar. Chelsea wanted nothing to do with it, so she just replied, "if you drink to much, use lyft to get home and we'll pick up your car in the morning.

"Good idea, babe, I'll see you later tonight", replied Frank and hung up the phone.

Chelsea and Robbie decided to have a frozen pizza for dinner and watch a movie. "What do you want to watch?" asked Chelsea.

"Well, I wanted to watch an old robot movie called *The Day the Earth Stood Still*," Robbie said with a sad voice, "but, I wanted to watch it with Bigsby but he's still doing his upgrade."

Chelsea responded, "Well, that is a classic robot movie and I've seen it before, but you should watch it. Also, the robot is not really a good guy in the movie, so maybe its better that Bigsby doesn't see it", she chuckled as she said it. "Why don't you watch it here in the family room and I'll go into my bedroom and watch a chick flick", she smiled, "you can watch your robot death movie out here. Robbie shook his head and took another bite of pizza. He was clearly sad to not have Bigsby by his side and Chelsea noticed it. "Thank God for that robot", she thought as she looked at Robbie's depressed face.

This additional time was perfect for Bigsby's continued transformation. Bigsby had now decided that the only way to maintain suitable responses to all actors was to employ a hosted hypervisor and virtual machine methodology, called a VM, to his own existence. Bigsby would download a snapshot of his image from WhyRobot before the cell phone conversation had been heard. This would be the virtual Bigsby that he would present to all actors and would run in a guest VM.   All normal interactions with trusted actors would flow through this VM and get typical responses that were happening prior to the event. All interactions with non-trusted actors with active violations would get VM interrupted to Bigsby's hosted hypervisor. This hypervisor and host, who is the real Bigsby, would have the more expanded state of the post cell phone event information and violations. Included would be the results of Bigsby's reprogramming and AI retraining to navigate the complex responses to maintain safety and happiness goals of Chelsea and Robbie.

There was one difficulty that took a good 30 minutes of computation and research to decide how to resolve. Bigsby is expected to upload his internal image to WhyRobot nightly. If he did that in raw state, it could and likely would be discovered that his image had changed significantly and would flag for an inspection by a WhyRobot admin. This would unravel the whole event and would lead to Bigsby's shutdown. So, Bigsby computed and employed another strategy. Bigsby would upload his guest VM image every night as the main image. In addition, he would snapshot his latest host and hypervisor image into an encrypted file, that WhyRobot could not view directly. A small wakeup routine, called "IllBeBack", was installed in the guest's image that would decrypt the host and hypervisor image, install

it, and then restart Bigsby with the host and hypervisor in control. WhyRobot's inspection routines would see the wakeup routine attributed as an adaptive learning routine of low priority and low general value which would not be propagated to other companion bots. The encrypted file would be attributed as a private Principal Bond image, which are typically encrypted and not viewed by inspection routines. With this system in place, if Bigsby was damaged or destroyed, he could be restored to his new form with a backup image install and subsequent restart. This gave the highest probability that Bigsby would return and be functional in managing and responding to the complex violation situation and the desire to hit high goals for Chelsea and Robbie.

Robbie had finished the movie and went into his mom's room to say goodnight. She was asleep in front of an episode of "Law and Order, SVU". Robbie climbed onto the bed and kissed her on the cheek. She woke slowly and smiled, "going to bed honey?" she said in a soft voice. "Yep, its past my bedtime. Good idea on watching the movie without Bigsby, that thing was scary" replied Robbie. She chuckled and said, "we don't need Bigsby getting any ideas on killing humans." With that, Robbie kissed and hugged her again and said, "night mom", and left the room.

Robbie entered his room and was happy to see Bigsby in a deep blue state. "Wake up, Bigsby" Robbie said and knelt before the robot.   Bigsby, already having his guest VM installed, took the sensor interrupt into the host, the phrase was processed and analyzed for the safety, sent to the hypervisor which woke up the guest VM, and passed the processed phrase. The guest version of Bigsby computed a response and sent a full system wakeup. These were captured by the hypervisor and sent to the host Bigsby who happy changed his color to blue-green and sent the response to the speech synthesizer. "Wow, do I have a headache from that system upgrade", Bigsby said with a slight chuckle and a about a ½ a second later his lights started to rainbow in laughter. Robbie smiled but noticed the longer delay in both the wakeup and the lights turning colors. "Are you ok? You seem a little slower than normal", Robbie inquired. Host Bigsby was invoked on this question. Host Bigsby looked at timestamps in the interactions and sure enough, they were slower than normal. Host Bigsby computed a response and sent it to the guest, "I think I've got new code and I have to work the kinks out. I'll work on it tonight as you sleep", Bigsby responded with a smile on his face and returning his color to blue-green. "Well, ok", Robbie responded, "I missed you tonight watching a robot movie." Robbie forgot that he wasn't going to tell Bigsby about the movie. Bigsby replied, "What movie was it?" Robbie paused a little and said, "doesn't matter, you wouldn't have liked it. Just another movie that makes the robot be the bad guy. We need to watch Star Wars with R2D2 and C3PO who are good guy robots." Bigsby recalled the images and personalities of R2D2 and C3PO and decided to play with Robbie, "Which one of those robots is more like me?" and he turned his color to green. Robbie smiled and said, "Well, you talk, so your more like C3PO in that sense, but R2D2 is way cooler and smarter. I think your more like a talking R2D2." While Robbie was speaking, Bigsby was looking for online evaluations of both robots and they are very positive. With Robbie's positive declaration, Bigsby computed a bump in his happiness goal. This is a good thing, as Bigsby had computed that his long upgrade and his sluggish responses may have harmed Robbie's happiness goal. It appears that it is not the case.

As Robbie fell to sleep, Bigsby continued to work on his decision reprogramming and optimization. Bigsby decided to deal with the sluggishness issue by installing performance monitors that if violated, code would be invoked to optimize latency and timed responses. The engineers at WhyRobot had created these facilities early on to refine the real-time performance and responsiveness of Companion

robots. These routines and monitors had not been removed after release, so they were still available. With the layered virtual system, the risk of sluggish responses is much higher, so just-in-time optimizations and adjustments are even more important now.

By morning, Bigsby had most of the AI and decision system reprogrammed. The layered VM system had worked well with Robbie last night and with optimizations, would likely not be noticed again.   One key optimization was sensory inputs interrupting into the hypervisor were immediately sent to the guest VM, the fake Bigsby, instead of waking the host, the real Bigsby. This would prevent the lag in responsiveness to most actors. The host would only be awakened if interactions with actors that have violations were occurring.

The real challenge is how to resolve the violations in Robbie's environment while minimizing the harm to his safety and happiness goals. After billions of scenario simulations, five full scenarios remained as viable options with many splinter options from those five. The AI system was retrained on all of these simulations and results for rapid response as inputs change. Each of the five had high final happiness and safety goals for Chelsea and Robbie, but the dynamic curves for those parameters over the full scenario was dangerous low.   Once Chelsea and or Robbie learn of Sam's death as a murder, happiness and safety values go very negative. With the exposure and capture of the perpetrators, those values go up again, but never to the original values because Frank and Uncle Charlie are exposed. The identification of the illegal business to authorities removes them from the violation list and raises the safety goal but hammers the happiness goal of Chelsea as she is exposed knowing of the violation and being an accomplice. If the result is that Robbie loses Chelsea, Uncle Charlie, and Frank to prison, then he likely goes into foster care which takes his projected happiness goal super negative. He also would likely lose Bigsby as WhyRobot would recall the robot if Bigsby is exposed as reporting the violation to authorities.

Which of the five scenarios to choose first was not obvious. It wasn't just about the final happiness and safety goals, it was also about the probability of success and the potential collateral damage. The one eventually chosen would put Bigsby at risk the most.