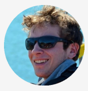


Setting up ECS with Terraform

2018-06-27

This document describes, for the AWS ECS noob, how to set up an AWS ECS cluster from scratch, entirely using Terraform.

If you're in a hurry, skip to the end to just get a module you can copy-and-paste.

Terraform is a tool that lets you declaratively describe the state of your infrastructure. Probably the best feature about it is that your infra's state is in version control, instead of ad-hoc scripts and here-be-dragons resources that somebody made by clicking around in the AWS UI.

The big downside, however, is that a lot of things in AWS aren't obvious to set up with Terraform. This document is a tutorial for one of the tougher things to figure out: starting a new AWS Elastic Container Service ("ECS") cluster, ready to start running services and tasks.

I'll assume you have already set up a working AWS provider for Terraform, and that you know how to issue `terraform` commands. I will *not* assume that you know exactly how ECS works. There will be helpful diagrams. There will be many AWS-related acronyms, and I usually won't presume you know what they mean.

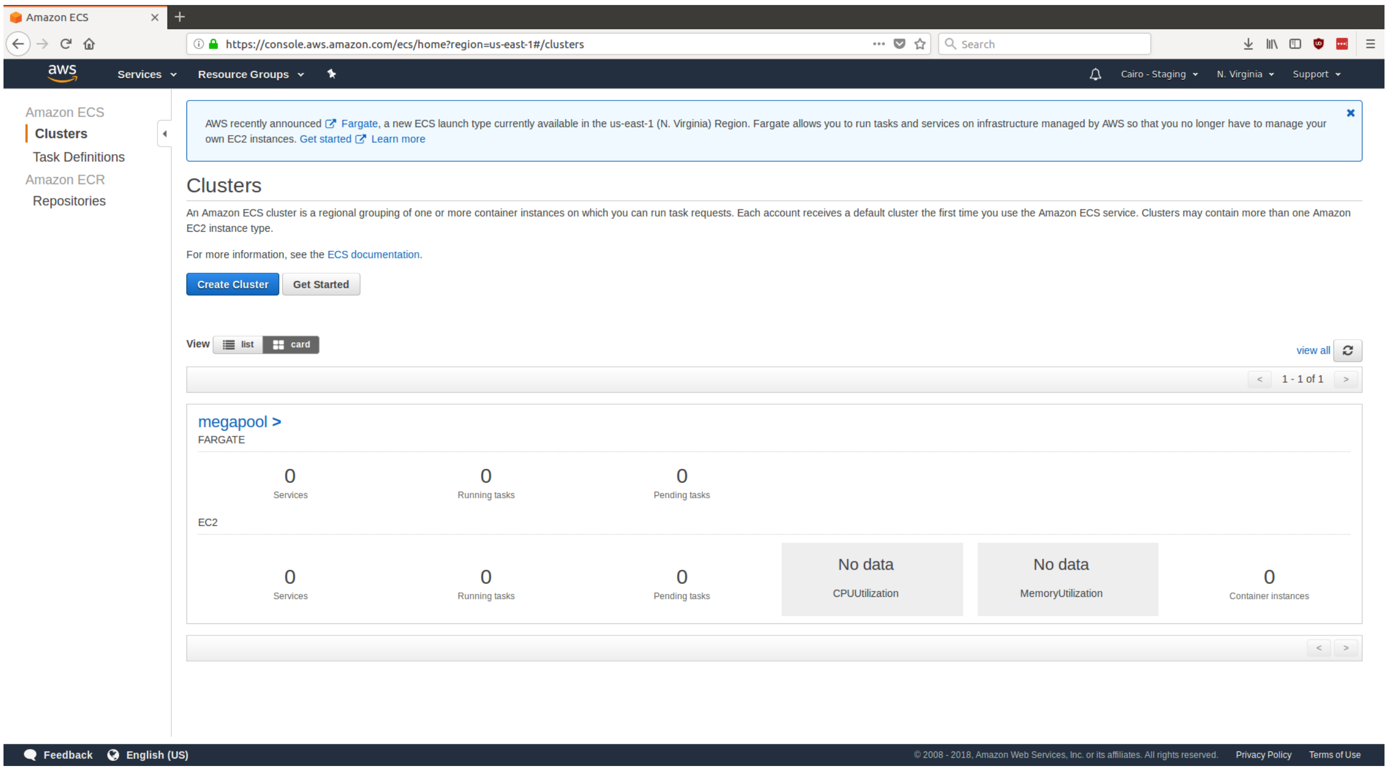
Creating the cluster

Throughout this demo, we're going to create a cluster called "megapool".

Actually creating the cluster is actually pretty easy:

```
resource "aws_ecs_cluster" "megapool" {
  name = "megapool"
}
```

Boom! The cluster is already there:



AWS recently announced Fargate, a new ECS launch type currently available in the us-east-1 (N. Virginia) Region. Fargate allows you to run tasks and services on infrastructure managed by AWS so that you no longer have to manage your own EC2 instances. Get started Learn more

Clusters

An Amazon ECS cluster is a regional grouping of one or more container instances on which you can run task requests. Each account receives a default cluster the first time you use the Amazon ECS service. Clusters may contain more than one Amazon EC2 instance type.

For more information, see the ECS documentation.

megapool >
FARGATE

0 Services	0 Running tasks	0 Pending tasks

EC2

0 Services	0 Running tasks	0 Pending tasks	No data CPUUtilization	No data MemoryUtilization	0 Container instances

Feedback
English (US)
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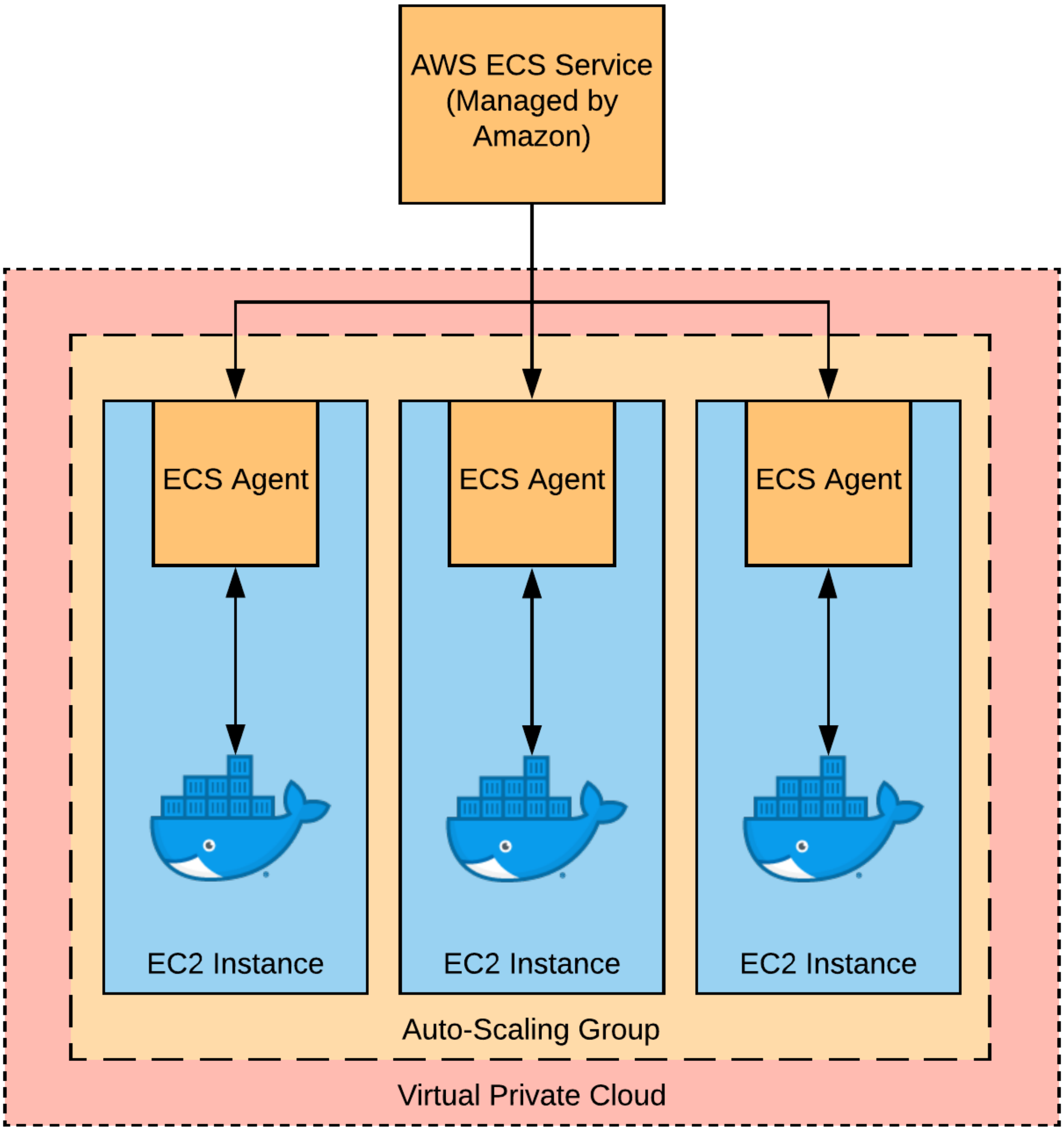
Adding instances to the cluster

There isn't much to this cluster yet. You could already at this point add ECS tasks or services to this cluster, but you can't actually *run* anything in this cluster yet. That's because you need to add EC2 instances to this cluster.

Unfortunately, Amazon hasn't made this process of adding EC2 instances super obvious for noobs. At this point, there will be a number of steps which we can't really validate until they all come together:

1. Add an Auto-Scaling Group ("ASG") for `megapool`.
2. Add a Launch Configuration (a sort of template telling AWS how to initialize machines) to that ASG.
3. Have that Launch Configuration use an Amazon Machine Image ("AMI"), a sort of virtual machine image, which will contain the ECS agent. The ECS Agent is responsible for talking to AWS's internal ECS APIs, and will register the EC2 instance to become a worker for `megapool`.
4. The ECS Agent needs a few permissions that aren't automatically given. So we'll need to add a few Security Group rules and some Identity and Access Management ("IAM") roles to grant those permissions. Security Group rules live within an AWS Virtual Private Cloud ("VPC"), so we'll create one of those as well.

That's a lot of stuff! Here's a picture of what needs to happen:



Adding the ASG

Let's first add an ASG which will contain all of the EC2 instances in our cluster.

```
resource "aws_autoscaling_group" "megapool" {
  name                 = "megapool"
  vpc_zone_identifier  = ["${module.vpc.private_subnets}"]
  launch_configuration = "${aws_launch_configration.megapool.name}"

  desired_capacity = 3
  min_size         = 3
  max_size         = 3
}
```

Though this won't "compile" yet, we've already here defined a group of three EC2 instances that will form the pool of machines running tasks in our cluster.

The auto-scaling group just defined is referencing two things we haven't defined yet: a VPC and a launch configuration. Let's add those next.

Adding the VPC

Adding a VPC properly is pretty annoying. So instead, let's just use a pre-defined one from the community:

```
module "vpc" {
  source = "terraform-aws-modules/vpc/aws"

  name = "vpc"
  cidr = "10.0.0.0/16"

  azs             = ["us-east-1a", "us-east-1b", "us-east-1c"]
  private_subnets = ["10.0.1.0/24", "10.0.2.0/24", "10.0.3.0/24"]
  public_subnets  = ["10.0.101.0/24", "10.0.102.0/24", "10.0.103.0/24"]

  enable_nat_gateway = true
  enable_vpn_gateway = true
}
```

Looking back up at the ASG we defined above, you can see that we had it use the private subnets of the cluster. That's because there's no reason the instances in the cluster need to have public IP addresses. If you want to make the services the cluster offers publicly addressable, add a load balancer to the public subnet, and have it call into the private one.

Adding the Launch Configuration

The other thing our ASG was missing was a launch configuration. This is where a lot of the magic happens. In particular, a launch config is where we tell AWS:

1. What image (AMI) to run on the instances – in our case, we'll use the "ECS Optimized AMI", which AWS maintains and is meant for running the ECS Agent (more on that later).
2. What permissions the instances should get, which allows us to give the instances the permissions ECS Agent requires.

3. How to initialize the instance – in particular, we'll set a configuration variable that the ECS Agent reads from to know the name of the cluster it's supposed to join.

Here's our launch configuration. A lot of the resources are still to be defined:

```
resource "aws_launch_configuration" "megapool" {
  name                 = "megapool"
  image_id             = "${data.aws_ami.ecs_optimized.id}"
  iam_instance_profile = "${aws_iam_instance_profile.ecs_agent.name}"
  security_groups      = ["${aws_security_group.allow_all.id}"]
  user_data            = "${data.template_file.user_data.rendered}"

  # You probably want to use something beefier. This is just for demo purpos
  instance_type = "t2.micro"
}
```

Notice that two of the properties – `image_id` and `user_data` – are `data` sources, not resources. That's because they don't actually correspond to AWS resources, they're just things we'll compute without asking AWS to create anything.

We don't need to create the `aws_ami` because AWS has already made it for us. In their docs, AWS has this great big table with the image ID you should use based on the region you're using.

We could reproduce that big table in Terraform, or we could just search for the AMI you want using Terraform's `aws_ami` data source, since the AMI always has the same name in every region:

```
data "aws_ami" "ecs_optimized" {
  filter {
    name   = "name"
    values = ["amzn-ami-2017.09.l-amazon-ecs-optimized"]
  }
}
```

The launch config user data is basically just a script to run once the machine boots up. On initialization, we want to set `ECS_CLUSTER=megapool` in `/etc/ecs/ecs.config`, which will tell ECS Agent what cluster to join.

```
data "template_file" "user_data" {
  template = "${file("${module.path}"/user_data.yaml)}"

  vars {
    ecs_cluster = "megapool"
  }
}
```

You’ll need to add a file called `user_data.yaml` alongside your `.tf` file with this in it:

```
#cloud-config
bootcmd:
 - cloud-init-per instance $(echo "ECS_CLUSTER=${cluster_name}" >> /etc/ecs/
```

At this point, we have everything set up! But it won’t work, because almost everything in AWS is default-deny. We still need to add security groups and IAM roles that will allow ecs agent to do its thing.

Adding the Instance Profile IAM Roles

Last step! We’re almost there. Though the EC2 instances will now have network access to the relevant ECS services, they won’t have permission to actually *do* anything.

Thankfully, AWS has us covered here. They’ve already defined an IAM policy that encompasses everything the ECS Agent needs to run – it’s called `AmazonEC2ContainerServiceforEC2Role`. We just need to give the EC2 service permission to do things on our behalf, by letting `ec2.amazonaws.com` assume roles in our account.

Let’s do that now:

```
# Define the role.
resource "aws_iam_role" "ecs_agent" {
  name               = "ecs-agent"
  assume_role_policy = "${data.aws_iam_policy_document.ecs_agent.json}"
}

# Allow EC2 service to assume this role.
data "aws_iam_policy_document" "ecs_agent" {
  statement {
    actions = ["sts:AssumeRole"]

    principals {
      type        = "Service"
      identifiers = ["ec2.amazonaws.com"]
    }
  }
}

# Give this role the permission to do ECS Agent things.
resource "aws_iam_role_policy_attachment" "ecs_agent" {
  role       = "${aws_iam_role.ecs_agent.name}"
  policy_arn = "arn:aws:iam::aws:policy/service-role/AmazonEC2ContainerServ
}
```

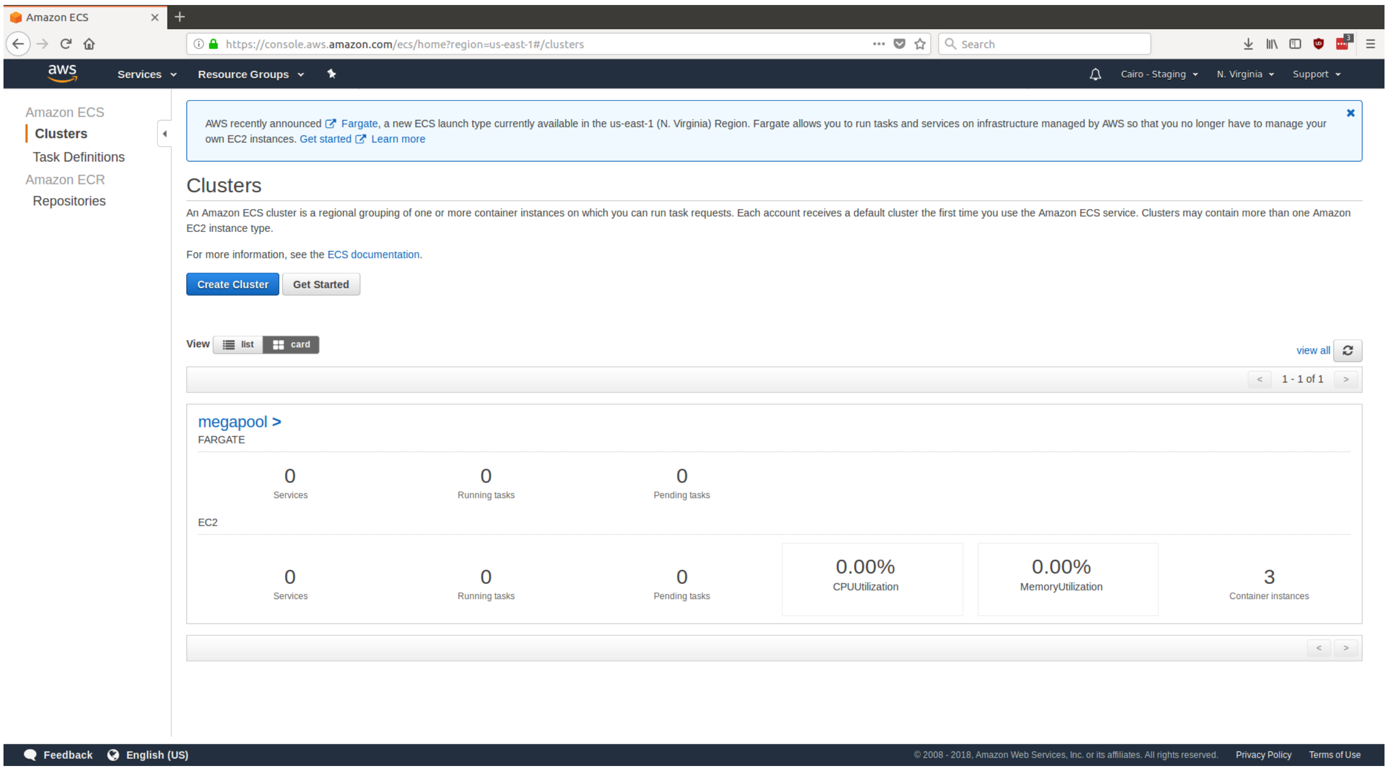
So far, all we've done is define a role. To actually have the launch configuration launch instances that use our role, we have to create an instance profile:

```
resource "aws_iam_instance_profile" "ecs_agent" {
  name = "ecs-agent"
  role = "${aws_iam_role.ecs_agent.name}"
}
```

Phew! And now we're done!

Testing that this worked

Let's make sure all of these steps actually worked. First of all, we can see that the EC2 instances really were added to the cluster:



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megapool >

FARGATE

0 Services	0 Running tasks	0 Pending tasks			

EC2

0 Services	0 Running tasks	0 Pending tasks	0.00% CPUUtilization	0.00% MemoryUtilization	3 Container instances

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(Note the "3 Container Instances" at the bottom right.)

Let's try to prove we can actually run a task on this cluster. Because we're running on `t2.micro` instances, there's not a ton we can actually do, but let's try doing a "hello world":

```
aws ecs register-task-definition \
  --family hello_world \
  --container-definitions '[{ "name": "hello_world", "image": "ubuntu", "mem
```

That container definition is pretty long-winded, but the gist of it is that we're running `/bin/bash -c "echo hello world $(date)"` on an `ubuntu` image. We're sending the logs to CloudWatch, so we can use any cloudwatch reader to read from them.

Let's now invoke the definition we just created:

```
aws ecs run-task \
  --cluster megapool \
  --task-definition hello_world:1
```

And use `cwlogs` to see the output:

```
$ cwlogs fetch hello_world
[ megapool-hello_world/hello_world/3fadff02-6d81-4197-9321-06d1c910b0d2 ] 04
```

Hooray! That's a successful end-to-end test. Our Terraform code works!

Possible Improvements

This post is meant to show you the minimal amount of work you'd need to do to hit the ground running. The additional details start to really depend on what you're trying to do, and I didn't want to get mired in details.

If *I* were you, here are a few improvements I'd consider making before taking this to prod:

Security Groups

We haven't added any security groups to our cluster instances. That means the containers on those instances can't talk to anything on the network. This wasn't an issue for our `hello_world` container, but you probably want to allow HTTP ingress and egress, as well as SSH traffic to/from your bastion instances.

Actual auto-scaling

Right now our "auto-scaling group" in fact doesn't scale at all. It will always stay fixed at three instances. You may want to add CPU- and memory-based scaling policies.

Bastion Servers

I mentioned this in the "Security Groups" improvement, but I'll elaborate here. As defined in this post, there's no way to SSH into the cluster instances. That's not ideal, and makes debugging stuff much harder. The solution to this is to add a bastion server, which exists only to bestow SSH access to other services.

The long-and-short of how you'd add a bastion is that you'd designate one of your public subnets as a "bastion" subnet, containing instances that aren't running any code (instances in this subnet are publicly addressable, so you want to make sure to limit your exposure). Then, with security groups allow SSH access from the bastion subnet to any of your private subnets. Grant a corresponding rule for your cluster instances that allows incoming traffic from the bastion subnet.

Finally, on both your bastion and cluster instances, add a public key of your choosing for access. Then, you can use SSH forwarding to connect to container instances from your personal computer via the bastions.

Copy-Pasteable Code

Here's all the code mentioned above, concatenated into a single file:

If you're just here to copy working code, the code below will work. But you might want to consider the "Possible Improvements" above.

```
module "vpc" {
  source = "terraform-aws-modules/vpc/aws"

  name = "my-vpc"
  cidr = "10.0.0.0/16"

  azs             = ["us-east-1a", "us-east-1b", "us-east-1c"]
  private_subnets = ["10.0.1.0/24", "10.0.2.0/24", "10.0.3.0/24"]
  public_subnets  = ["10.0.101.0/24", "10.0.102.0/24", "10.0.103.0/24"]

  enable_nat_gateway = true
  enable_vpn_gateway = true
}

resource "aws_ecs_cluster" "cluster" {
  name = "megapool"
}

resource "aws_autoscaling_group" "cluster" {
  name                 = "megapool"
  vpc_zone_identifier  = ["${module.vpc.private_subnets}"]
  launch_configuration = "${aws_launch_configuration.cluster.name}"

  desired_capacity = 3
  min_size             = 3
  max_size             = 3
}

resource "aws_launch_configuration" "cluster" {
  name                 = "megapool"
  image_id             = "${data.aws_ami.ecs_optimized.id}"
  iam_instance_profile = "${aws_iam_instance_profile.ecs_agent.name}"
  user_data            = "${data.template_file.user_data.rendered}"
  instance_type        = "t2.micro"
}

data "aws_ami" "ecs_optimized" {
  filter {
    name   = "name"
    values = ["amzn-ami-2017.09.l-amazon-ecs-optimized"]
  }
}

data "template_file" "user_data" {
  template = "${file("${path.module}/user_data.yaml")}"

  vars {
    ecs_cluster = "megapool"
  }
}

# Define the role.
resource "aws_iam_role" "ecs_agent" {
  name               = "ecs-agent"
  assume_role_policy = "${data.aws_iam_policy_document.ecs_agent.json}"
}

# Allow EC2 service to assume this role.
data "aws_iam_policy_document" "ecs_agent" {
  statement {
    actions = ["sts:AssumeRole"]

    principals {
      type        = "Service"
      identifiers = ["ec2.amazonaws.com"]
    }
  }
}

# Give this role the permission to do ECS Agent things.
resource "aws_iam_role_policy_attachment" "ecs_agent" {
  role       = "${aws_iam_role.ecs_agent.name}"
  policy_arn = "arn:aws:iam::aws:policy/service-role/AmazonEC2ContainerServ
}

resource "aws_iam_instance_profile" "ecs_agent" {
  name = "ecs-agent"
  role = "${aws_iam_role.ecs_agent.name}"
}
```

You also need to add `user_data.yaml` alongside the `*.tf` file:

```
#cloud-config
bootcmd:
 - cloud-init-per instance $(echo "ECS_CLUSTER=${cluster_name}" >> /etc/ecs/
```

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