Continuous Integration with Jenkins

Summary

In this tutorial, you'll be introduced to the concept of continuous integration - a way of checking that the code you and your team is producing is suitable for inclusion in the main builds, across all of the target platforms. To enable the usage of continuous integration with your team project, you will be shown how to use the Jenkins continuous integration platform, including how to set up users, connect it to your code repository, get the platform building all of your different configurations, and what to do if one of the builds has failed.

Continuous Integration Background

Unless you are working solo on a personal project, it is likely that the software you develop in the future will be made as part of a team, with multiple programmers working on producing code that must interact correctly with the contributions of others. This is primarily achieved via the use of a *code repository* that users commit their work to, and retrieve previously committed changes to the files that comprise the program being worked on. It is common for such tools to support *versioning*, whereby changes can be undone if necessary, and every committed change to a set of files creates a 'checkpoint' that can be used to identify when bugs and problems have been introduced into the software, or when new features have been created.

With large codebases, many of these version checkpoints may be generated per day, and not every programmer will have their own local copy of the codebase up to date with the latest versioning checkpoint, and may have begun changing a file which is now out of date with the latest version by the time they are at the point they can commit their code changes. When this occurs, its common for the versioning tools to provide the ability to 'merge' files together, combining the changes one programmer has made with those that have been committed since the changes were developed.

As each programmer will be at a different repository checkpoint, it is inevitable that at some point, someone is going to commit code that breaks the compilation of the project. This is especially true in cases where the software may be built in a number of different configurations - some code that compiles fine with the compilation toolchain of one platform may break on that of a different platform. Being able to quickly identify cases where problems with integrating code changes arise is important - broken code can hold up the project, and may point to fundamental software architecture problems that must be tackled.

Ideally, every code change will be tested against every possible configuration the codebase can be in before being committed to ensure that nothing gets fundamentally broken by the change. In practice, however, this is impractical - checking that a single line of code being changed successfully compiles in the debug and release modes of the Windows, PlayStation, and Android versions of a codebase takes a lot of time, time that the programmer cannot actively program in, and time in which the programmer is falling further behind the latest versioning checkpoint.

This problem keeps getting worse, too - it's common to have many different configurations per platform (along with debug and release, there may be specific configurations that enable testing features, or experimental functionality), or the versioning of the codebase itself may have been 'branched' to allow concurrent development of different features, in which case a code change may work fine in one branch, but cause problems in another!

The solution: *Continuous Integration*

The solution to this problem of assessing the validity of the code being submitted is to automate the process to compiling code as it is submitted to the code repository, and verifying that all of the required configurations are in a working state. This is achieved via the usage of *continuous integration* tools. As the name suggests, these will continuously try and compile the changes being submitted to a code repository, and report on the success (or failure!) of the compilation. These tools generally run on a dedicated server machine, and are often controlled via a web interface. Some of these integration tools will also support *distributed* compilation, a process whereby the spare resources of the developer's machines are used to compile parts of the program, which can allow builds to be generated quicker than relying upon a single server machine, and thus inform programmers of any potential errors as quickly as possible.

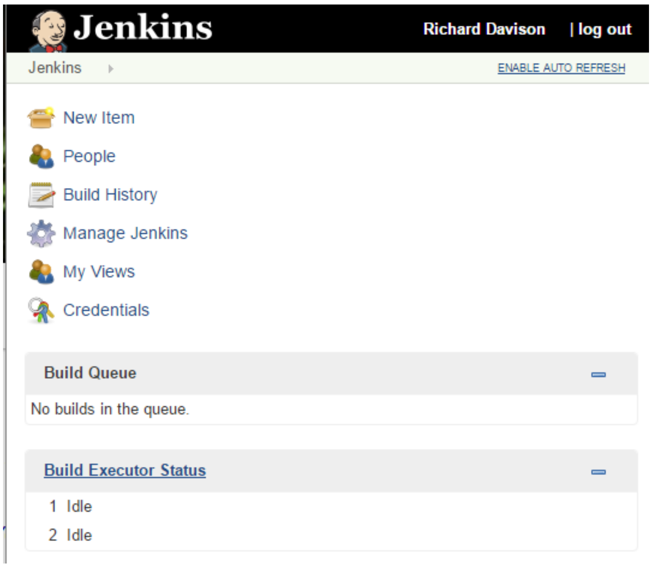
Introduction to Jenkins

One popular continuous integration tool, and the one we will be concentrating on here is *Jenkins*, an open source server program, that can connect to a wide number of code repository types, and generate compilation results from a number of programming languages. While anyone can download and use the tool as they wish (from *https://jenkins.io*), for the purposes of your team project each team has been provided with a freshly installed version of Jenkins on a University-based Windows machine, allowing you to configure it as necessary, and benefit from not having to risk slowing down one of your team's machines by making it constantly compile whenever a change is made.

Jenkins has a number of capabilities that will be useful to you - it can trigger *Visual Studio* builds, and connect to repositories in popular formats such as Perforce, Subversion, and Git. If it detects a compilation failure, it can email team members to inform them that the build has failed (or become *unstable* in Jenkins parlance), when it has started working again, and can also email specifically the person who committed the change that resulted in the build failing, letting them know that there is an issue that should be resolved immediately.

Managing Jenkins

Jenkins is managed entirely through a web interface - you will be emailed the address of your team's Jenkins server at the start of your team project. By navigating to the address via a web browser, you should find yourself at the main Jenkins control panel, which should look similar to the following:



No builds in the queue.

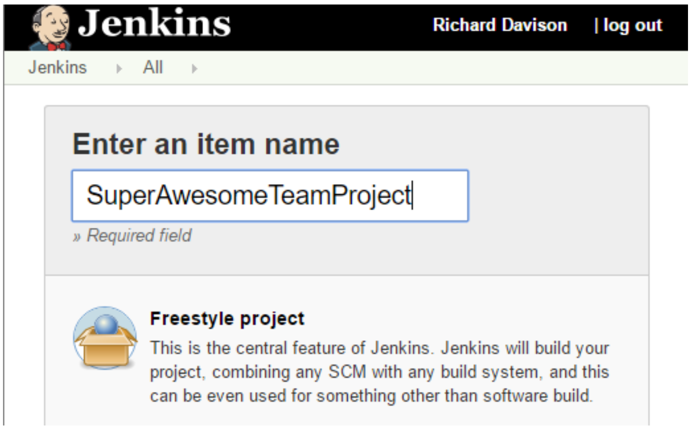
1 Idle

2 Idle

Creating Projects

Your first stop in Jenkins is to create a *project*. Think of this as being like a Visual Studio solution, in that it contains all of the configuration settings required to execute its task - in this case continuous integration of code. To create a new project, click on the *New Item* button from the Jenkins menu on the left of the *Configuration* screen:

From there, you can name your project, and specify its type. Click on *Freestyle project*, and then *OK*. This type of project allows for the greatest range of options to configure what Jenkins should do, so should be a good starting point for however you wish to configure your continuous integration setup.



Enter an item name

SuperAwesomeTeamProject

» Required field

Freestyle project

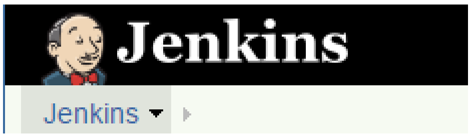
This is the central feature of Jenkins. Jenkins will build your project, combining any SCM with any build system, and this can be even used for something other than software build.

Upon clicking *OK*, you'll be sent to the *Configuration* page. This has a number of tabs for setting options on various parts of how Jenkins will operate. You'll be seeing a lot of this page, as to get Jenkins compiling the code for your team project you have to do a bit of setting up of various components of the system.

Installing Plugins

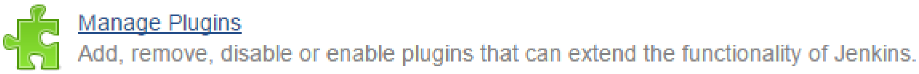
A freshly installed Jenkins instanced doesn't do very much! For it to become a useful tool you must configure it to connect to your code repository, and compile the code in a specified manner. Depending on the repository and compilation toolchain you use, you may need to extend the functionality of Jenkins with a number of plugins, too. As it doesn't come with support for Visual Studio projects by default, you are definitely going to have to handle plugins at some point, so we'll start by taking a look at how to obtain and configure the Visual Studio plugin.

The process for installing Jenkins projects is reasonably straight forward. To start off with, click on the *Jenkins* icon at the top of the web page:



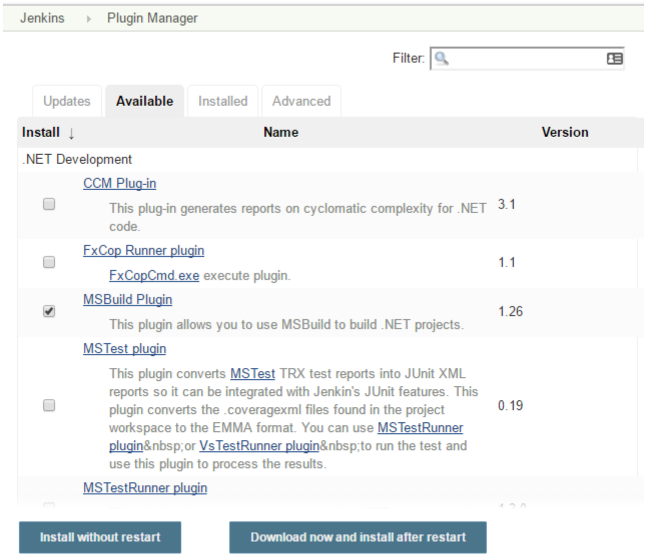
This will take you to the root of the options Jenkins can provide on its left hand list. From this list, select *Manage Jenkins*:

This will open up a selection of options in the right hand pane - select *Manage Plugins*:



Add, remove, disable or enable plugins that can extend the functionality of Jenkins.

This will then show tabs that can display installed plugins, those that have new updates to install, and new plugins available for installation. As Visual Studio will be your main IDE during the team project, Jenkins is going to have to be capable of building Visual Studio solution files. It's possible to compile a Visual Studio project from the command line using the Visual Studio *MSBuild* tool. Jenkins has a plugin available to use with MSBuild, so from the plugin management part of the web interface, click on the *Available* tab, and tick the box to the left of the *MSBuild* plugin entry.

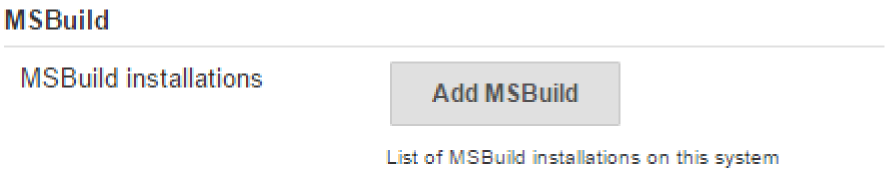


Install ↓	Name	Version
	.NET Development	
□	CCM Plug-in This plug-in generates reports on cyclomatic complexity for .NET code.	3.1
□	FxCop Runner plugin FxCopCmd.exe execute plugin.	1.1
☑	MSBuild Plugin This plugin allows you to use MSBuild to build .NET projects.	1.26
□	MSTest plugin This plugin converts MSTest TRX test reports into JUnit XML reports so it can be integrated with Jenkin's JUnit features. This plugin converts the .coveragexml files found in the project workspace to the EMMA format. You can use MSTestRunner plugin or VsTestRunner plugin to run the test and use this plugin to process the results.	0.19
	MSTestRunner plugin	

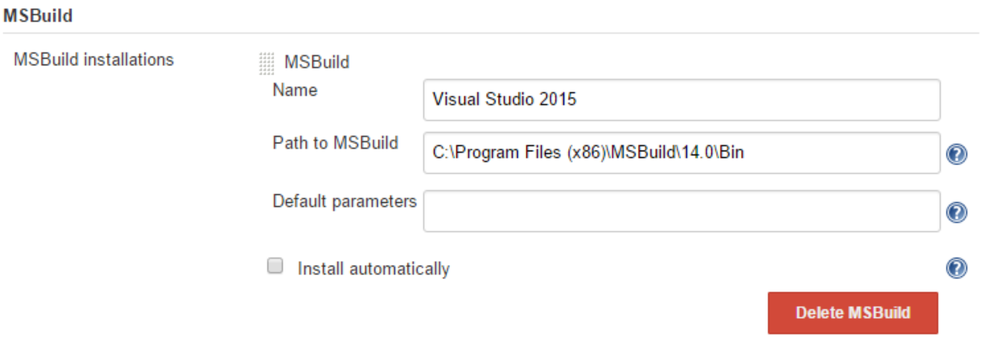
Once you've done this, click on the *Install without restart* button at the bottom of the page. That's it! That's all you need to do to install plugins.

Configuring Plugins

Some plugins add new memu items or items within your project settings, but some must have additional properties set specifically for them. The *MSBuild* plugin is like this, so now's a good time to see more of the configuration options Jenkins has. Return to the *Manage Jenkins* option we used earlier, but instead of going to *Manage Plugins*, instead go to *Global Tool Configuration.* Towards the bottom of the resulting menu, you should see that there's now an *MSBuild* option in the right hand pane - navigate towards it and press the *Add MSBuild* button.



This will expand some options specific to the *MSBuild* plugin, in this case the location of the MSBuild executable, installed as part of Visual Studio. Add the following name and path to your configuration, and then press *Save*:



MSBuild

MSBuild installations

MSBuild

Name: Visual Studio 2015

Path to MSBuild: C:\Program Files (x86)\MSBuild\14.0\Bin

Default parameters:

☐ Install automatically

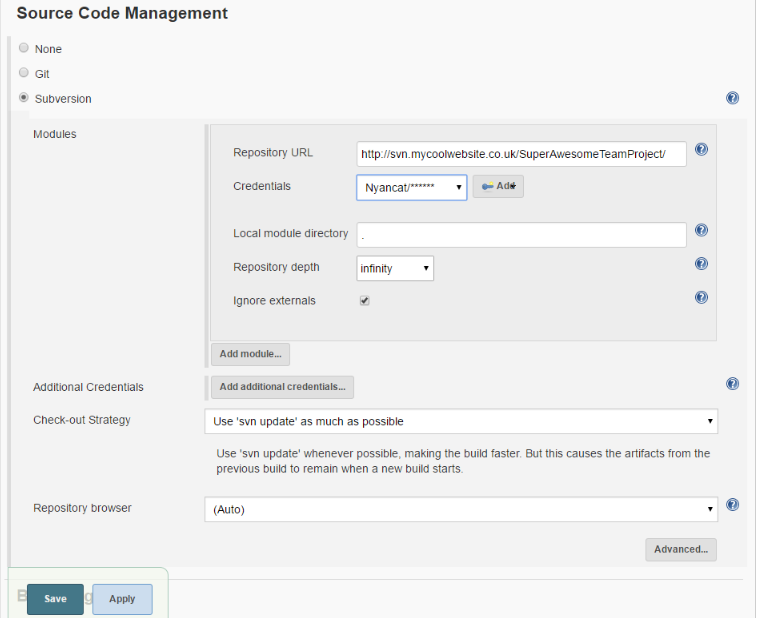
That's all we need to do to set up the MSBuild plugin, although we'll see some per-project settings relating to solution files later on.

Repositories

To obtain your team's code, Jenkins must be able to connect to the repository it is being committed to. As part of its default installation, Jenkins comes with support for *Git* and *Subversion* repositories - if your team has chosen another software versioning system, you will have to seek out and install the Jenkins plugin for it, in similar manner to the *MSBuild* plugin described earlier.

Subversion

To get Jenkins to connect to a Subversion repository, you will have to modify the properties of the project - to do this, click on the Jenkins icon in the top left, and then select your project from the right hand pane. Then, from the left pane, select *Configure* - this takes us back to the main configuration page that we saw earlier. Scroll down to the *Source Code Management* section of the left hand pane, and select *Subversion* - this will open up a set of options for accessing an SVN repository. As with anything else that tries to get the latest version of an SVN repository, Jenkins will need to know the URL, and have the correct credentials. If your repository isn't publically accessible, you will have to add a user to your repository for Jenkins to log in as, just as with any members of your team.



Source Code Management

○ None

○ Git

● Subversion

Modules

Repository URL: http://svn.mycoolwebsite.co.uk/SuperAwesomeTeamProject/

Credentials: Nyancat/******

Local module directory: .

Repository depth: infinity

Ignore externals: ☑

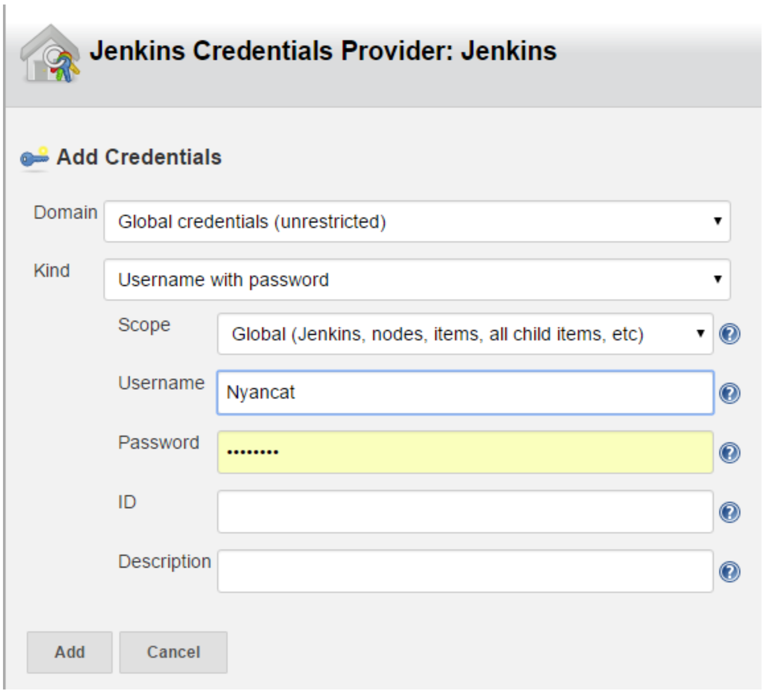
Additional Credentials

Check-out Strategy: Use 'svn update' as much as possible

Use 'svn update' whenever possible, making the build faster. But this causes the artifacts from the previous build to remain when a new build starts.

Repository browser: (Auto)

To give Jenkins the credentials required to log in to your Subversion repository, click on the *Add* button next to the *Credentials* box in the left hand pane, then select *Jenkins* from the pop up box. This should bring up a menu that looks like the following:



Jenkins Credentials Provider: Jenkins

Add Credentials

Domain: Global credentials (unrestricted)

Kind: Username with password

Scope: Global (Jenkins, nodes, items, all child items, etc)

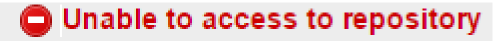
Username: Nyancat

Password: ••••••••

ID:

Description:

Add your newly created user name and password here, leaving all other options default (they should be as in the image). Once you've clicked *Add*, you'll return to the *Configuration* screen automatically. At this point, Jenkins will also try and log in to the Subversion repository; if something has gone wrong (such as typing the password wrong), then you'll see a red warning sign like this appear:

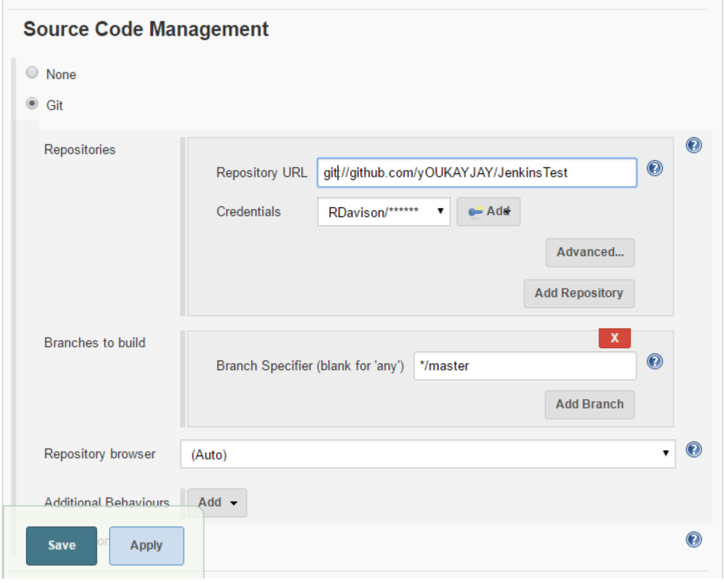


Unable to access to repository

Otherwise, you're all set! Just press *Save* and Jenkins will then be able to connect to your repository and grab the latest version of the files on it.

Git

Adding a Git repository is much the same as with Subversion. From the *Source Code Management* section of the *Configuration* page, select the *Git* option, and then add the URL to your repository. If the repository is private, you'll need to add the required credentials to Jenkins, as with the SVN repository example earlier. If your repository uses SSH authentication, you'll need to add this to the user afterwards; modifying users is discussed in this tutorial later on.



Source Code Management

○ None

● Git

Repositories

Repository URL: git://github.com/yOUKAYJAY/JenkinsTest

Credentials: RDavison/****** ▾

Branches to build

Branch Specifier (blank for 'any'): */master

Repository browser: (Auto) ▾

Additional Behaviours

Triggering Builds

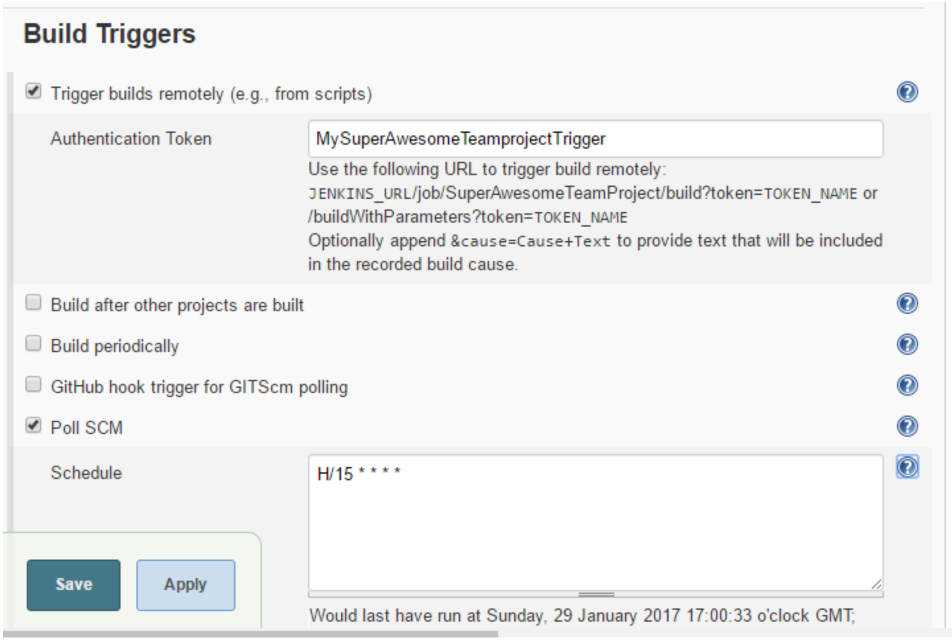
Now that you've set up Jenkins to access your repository, you can start to set up how often it should attempt to get the latest version and compile it. In the *Configuration* menu you used earlier for setting up your repository, there's a section for *Build Triggers*. From here you can enable and disable a number of different options for determining when Jenkins should attempt to build your project. The two ways we're going to be taking a look at are by *polling* the repository, and by automatically *triggering* a Jenkins build remotely.

Of the two methods, polling is the easier to set up. As its name suggest, enabling polling will make Jenkins periodically request the latest version of the repository, and if it is more up to date than when it last built anything, will download and build the newest version. This is easy to set up using a schedule, but does have some drawbacks; one is that Jenkins may take a while to notice changes if the schedule is not fast enough, delaying you from being notified of problems, and secondly periodically talking to another server takes up bandwidth, which may well be wasted during periods when no commits are being made to the repository.

To set up polling, tick the *Poll SCM* box of the *Build Triggers* menu. This will bring up an additional *Schedule* text box. In this box goes some special syntax for controlling when Jenkins should poll the repository - There should be five fields, separated by a space, which control what Jenkins will do per minute, per hour, per day of the month, per month, and per day of the week. For each field, you can specify a range of values that determine how often builds occur; with the '*' symbol used to indicate that all valid values should be used. This might sound confusing at first, but it might make more sense if we just look at some examples.

The most simple thing we could put in the Schedule box is '* * * * *'. This equates to 'for every minute, in every hour, in every day of the month, in every month, no matter which day of the week it is, run a build'. This would work, but polling once a minute will use a lot of bandwidth, and resources! Instead, we could use the synatx '*/15 * * * *' - this will split the minutes up into 15 minute segments, so instead Jenkins will poll 4 times an hour. Another option would be to use 'H/15 * * * *' - in this case the H stands for *Hash*, and is used to generate a random value, on a per-project basis. Without this, the repository would be polled exactly every 15 minutes, start from on the hour - if you have many projects, this will mean Jenkins will poll all of them at the same time! By adding the hash, each project will get its own starting value, spreading the load out over time. To get started, use the 'H/15 * * * *' syntax so that at least Jenkins will do *something*!

While polling will work pretty well, there is a way that can avoid wasted time and bandwidth caused by polling a build that hasn't changed. Many software versioning packages, including Subversion and Git, *support post-commit hooks* - small tasks that can be executed by the versioning system upon a successful commit by a user. The exact method of creating one of these hooks is dependent on specifics of the installation used, but they can commonly be set up to visit a website address; Jenkins can record visits to a special URL and use it to trigger a build. To enable this feature, tick the *Trigger builds remotely* box in the *Build Triggers* menu. You will then be asked to create an *Authentication Token*, a string that forms part of the specially crafted URL used to trigger builds. Simply fill this in with something unique, and make note of the URL noted underneath; you can test that this will trigger a build by opening a new web browser tab and going to it - you won't see anything when it loads, but looking back at your Jenkins tab should show that a build has been scheduled.



Build Triggers

☑ Trigger builds remotely (e.g., from scripts)

Authentication Token: MySuperAwesomeTeamprojectTrigger

Use the following URL to trigger build remotely: JENKINS_URL/job/SuperAwesomeTeamProject/build?token=TOKEN_NAME or /buildWithParameters?token=TOKEN_NAME

Optionally append &cause=Cause+Text to provide text that will be included in the recorded build cause.

☐ Build after other projects are built

☐ Build periodically

☐ GitHub hook trigger for GITScm polling

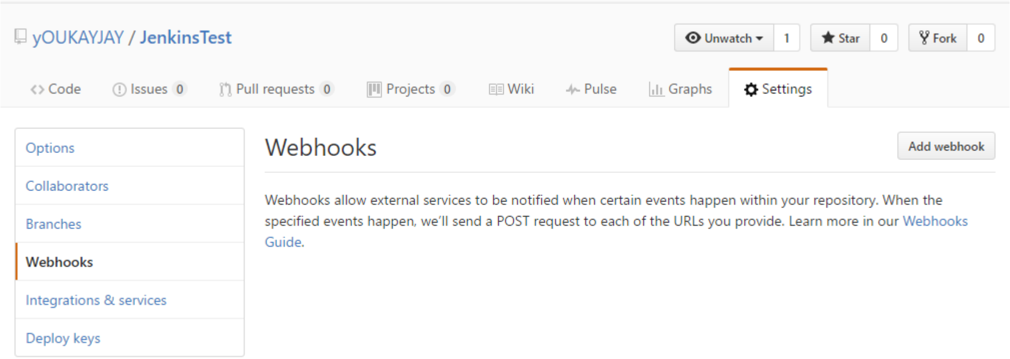
☑ Poll SCM

Schedule: H/15 * * * *

Would last have run at Sunday, 29 January 2017 17:00:33 o'clock GMT;

Triggering Builds In *GitHub*

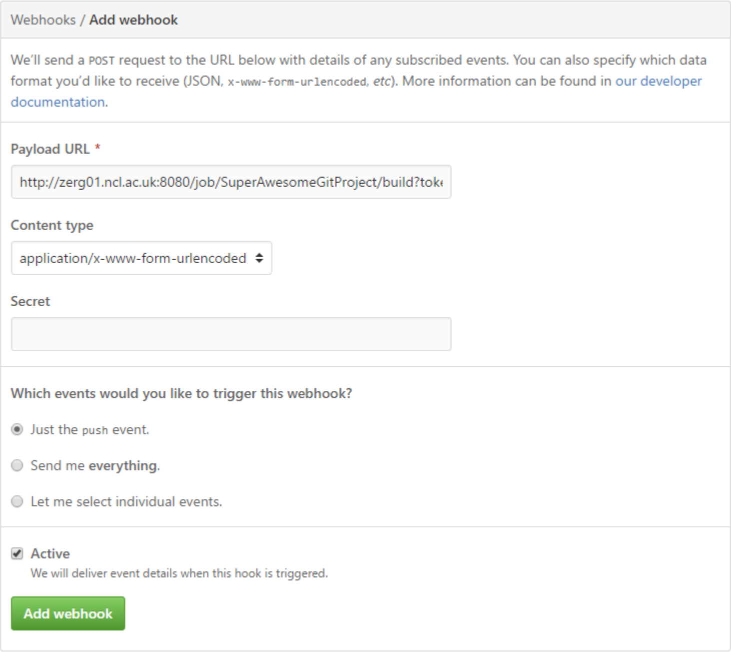
It's worth having a quick look at how to configure post-commit hooks in two popular source code control websites, *GitHub* and *Gitlab*; they're both pretty easy! In *GitHub*, a user marked as administrator for a repostiory can add post-commit hooks by logging in to the website, navigating to the desired project, and going to *Settings* along the top menu, and then *Webhooks* down the left hand side:



Webhooks

Webhooks allow external services to be notified when certain events happen within your repository. When the specified events happen, we'll send a POST request to each of the URLs you provide. Learn more in our Webhooks Guide.

Once there, you'll be able to paste the URL from earlier into the *Payload URL* section - don't forget to add the Authentication Token!



We'll send a POST request to the URL below with details of any subscribed events. You can also specify which data format you'd like to receive (JSON, x-www-form-urlencoded, *etc*). More information can be found in our developer documentation.

Payload URL *

http://zerg01.ncl.ac.uk:8080/job/SuperAwesomeGitProject/build?tok

Content type

application/x-www-form-urlencoded

Secret

Which events would you like to trigger this webhook?

● Just the push event.

○ Send me **everything**.

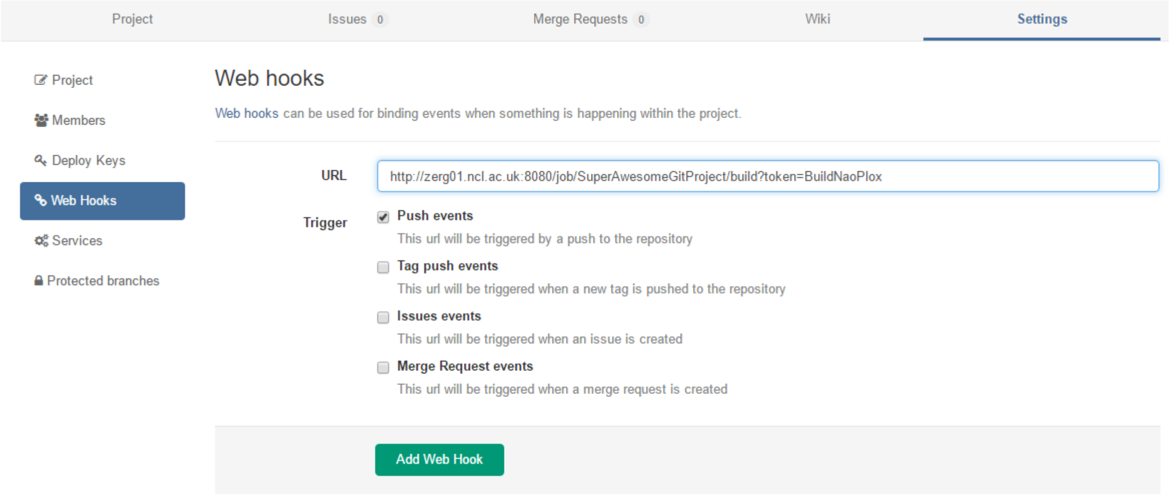
○ Let me select individual events.

☑ Active

We will deliver event details when this hook is triggered.

Triggering Builds In *GitLab*

The process for GitLab is pretty similar to that of GitHub - log into the website, navigate to the project you want to continuously integrate, select *Settings* from the top menu, then *Web Hooks* from the left. From there, you should be able to paste the URL you made note of earlier.



Web hooks

Web hooks can be used for binding events when something is happening within the project.

URL http://zerg01.ncl.ac.uk:8080/job/SuperAwesomeGitProject/build?token=BuildNaoPlox

Trigger

☑ **Push events**

This url will be triggered by a push to the repository

□ **Tag push events**

This url will be triggered when a new tag is pushed to the repository

□ **Issues events**

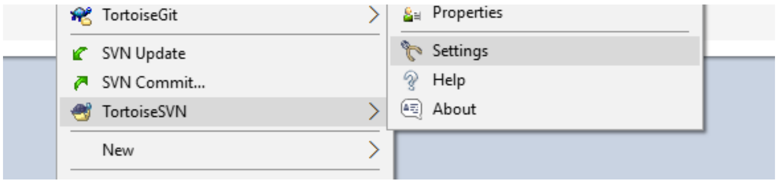
This url will be triggered when an issue is created

□ **Merge Request events**

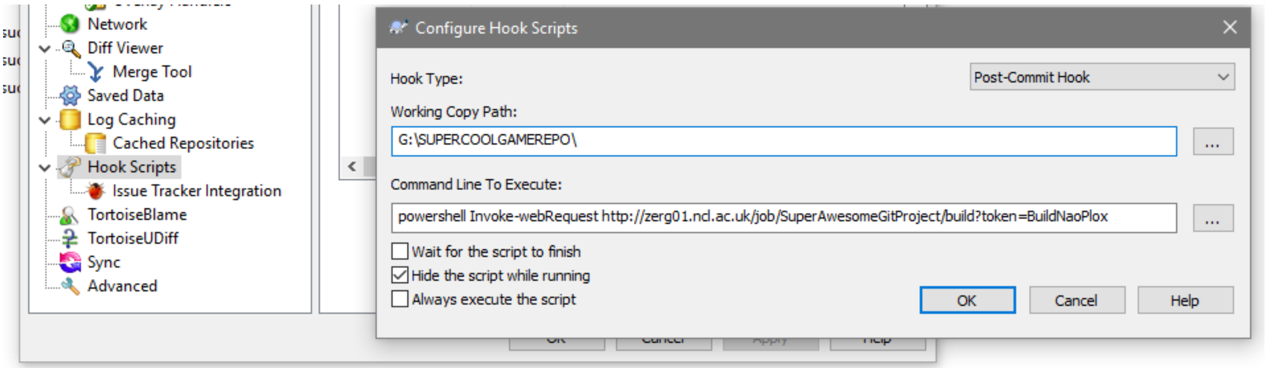
This url will be triggered when a merge request is created

Triggering Builds From Tortoise

Sometimes it's not possible to trigger Jenkins builds from your code repository directly - if Jenkins is running on a non web-facing machine, for example. In those cases, it's also possible to trigger a new build automatically upon commiting code from the software client you are using to communicate with your repository. A popular package for both Subversion and Git is *Tortoise*, which hooks itself into Windows itself so that simply right clicking on a repository folder will allow you to commit code and update your local copy of a repository. To enable post commit hooks in either *TortoiseGit* or *TortoiseSVN*, first right click on your repository, hover over the *Tortoise* sub menu, and select *Settings*, as shown:



From the newly-opened settings menu, navigate to the *Hook Scripts* option, and then click *Add*. This will bring up a menu similar to the following:



Hook Type: Post-Commit Hook

Working Copy Path: G:\SUPERCOOLGAMEREPO\

Command Line To Execute: powershell Invoke-webRequest http://zerg01.ncl.ac.uk/job/SuperAwesomeGitProject/build?token=BuildNaoPlox

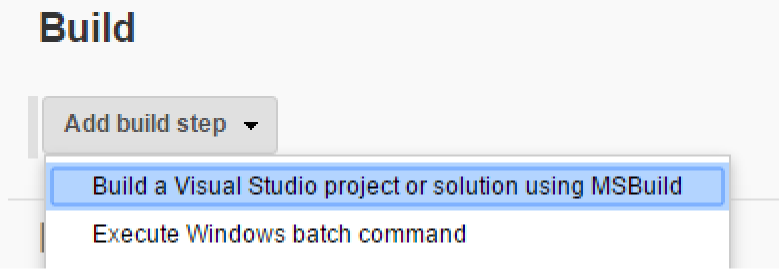
□ Wait for the script to finish
☑ Hide the script while running
□ Always execute the script

You can then fill in the path you wish to treat as your repository root, and a command to execute. In the example above, the Windows *PowerShell* command has been used, along with the Invote-webRequest option, which can send a request to a website - enough to load up the build trigger page of your Jenkins project and get a new build scheduled! You may have to manually install PowerShell from the Microsoft website: **msdn.microsoft.com/en-us/powershell/mt173057.aspx**, as not all versions of the OS come with it pre-installed.

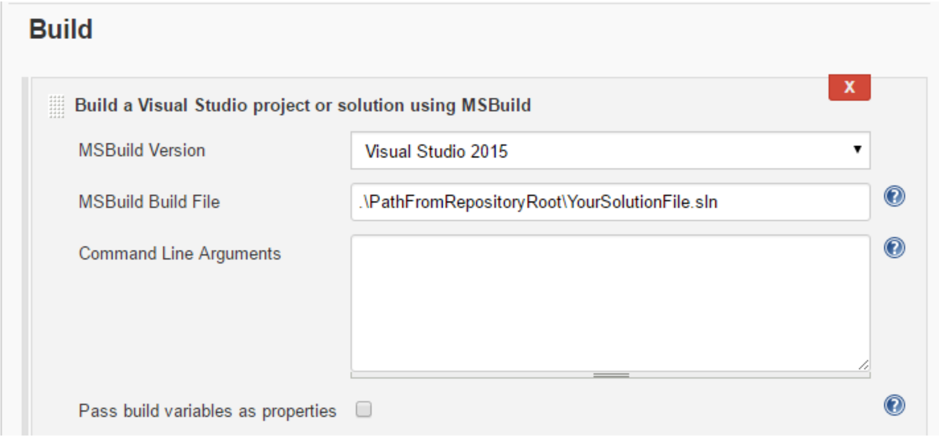
You should only utilise client-side hooks like these as a last resort - having the repository itself trigger the builds is more reliable, as all it takes is one programmer to forget to include the client side hook to end up with Jenkins missing out on some potentially quite important code changes being committed!

Compiling Builds

Now that Jenkins has been augmented with the *MSBuild* plugin, and been told where to get the code to build from, it's time to tell it exactly how to build the projects. As with *Build Triggers*, this is done by navigating to the *Configuration* menu, except this time we're going to go to the *Build* tab. From the menu, press *Add Build step*, and then select *Build a Visual Studio Project or solution using MSBuild* - this option wouldn't be there if we hadn't installed the *MSBuild* plugin earlier.


Build
Add build step
Build a Visual Studio project or solution using MSBuild
Execute Windows batch command

Upon selecting the *Visual Studio* option, the menu will expand, giving us the following:



Build

Build a Visual Studio project or solution using MSBuild

MSBuild Version: Visual Studio 2015

MSBuild Build File: .\PathFromRepositoryRoot\YourSolutionFile.sln

Command Line Arguments:

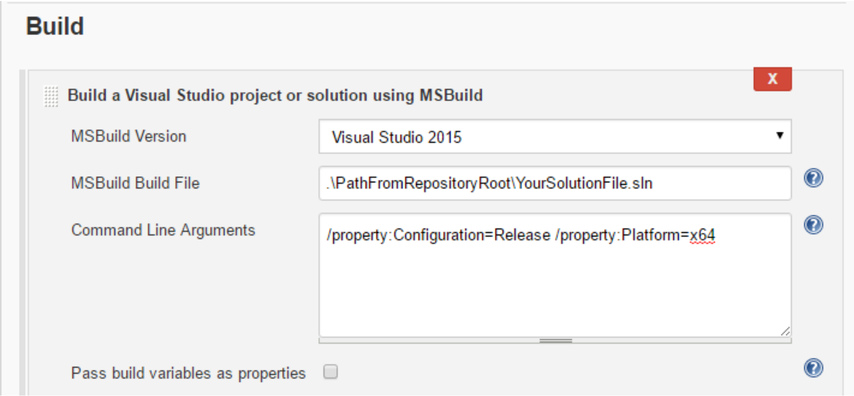
Pass build variables as properties ☐

In the *MSBuild Version* drop-down box, you should be able to select *Visual Studio 2015* - this is the MSBuild version we entered a name and file path for earlier. For the *MSBuild Build File* option, you should enter the path from the repository root to the solution file - don't forget to include the .sln part! If we now press *Save*, Jenkins will finally be able to download the latest checkpoint in a code repository and build it!

Different Build Configuration

One of the problems continuous integration can solve is the combinatorial explosion of configurations and platforms that a software project may be targetted for; whether debug or release builds, PC or PlayStation, real network connections or a test harness, and so on. So far, we've only told Jenkins to compile a Visual Studio solution, but not which configuration, or which platform. By default, Jenkins will just use whichever was set to the default when the solution file was uploaded to the repository, so probably a debug win32 build. This is still useful as it will be able to detect obviously broken code problems such as missing semi colons or mistyping variable names, but it can do more.

You may have noticed when setting up the Build pane earlier, that the *Add Build* step button didn't go away once we'd added an MSBuild step. Jenkins can actually perform many tasks when running a scheduled build, including multiple instances of an MSBuild configuration - each of these instances could be a different platform or configuration. The exact platform and configuration to compile is defined by the command line arguments passed on to MSBuild. To try this out, navigate back to the project *Configuration* pane in Jenkins, and find the *Build* section we filled in earlier. As before, click *Add build step*, and then *Build a Visual Studio project or solution using MSBuild*. This time, however, try filling in the *Command Line Arguments* section as follows:



Build

Build a Visual Studio project or solution using MSBuild

MSBuild Version: Visual Studio 2015

MSBuild Build File: .\PathFromRepositoryRoot\YourSolutionFile.sln

Command Line Arguments: /property:Configuration=Release /property:Platform=x64

Pass build variables as properties ☐

After you've clicked *Save*, you'll find that next time Jenkins runs a build, it'll build the project twice, once in the default configuration and platform, and once specifically in *Release* mode, for the *x64* platform. Using the same process, you can build debug and release versions of your Android and PlayStation 4 versions of the codebase - Jenkins doesn't know or care about what platforms you use, just as long as you've installed the correct toolchains for MSBuild to find and utilise.

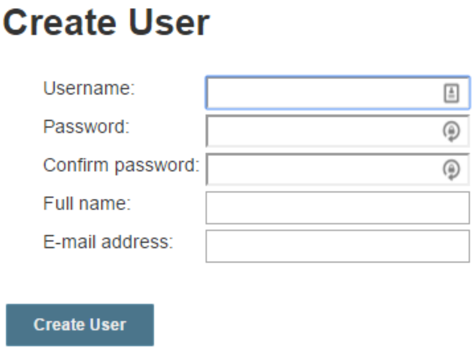
Creating Users

At this point, you should be able to get Jenkins to connect to your repository, and build it in all the configurations you need, either periodically, or when a new commit has been made. At some point, however, Jenkins is going to need to tell the outside world the current state of the project, especially if it has become unstable in one of the combinations of configuration and platform. To do this, it can email users about the state of the project upon completion of a compilation attempt. Users can be added to Jenkins in two ways - either manually from the control web page, or automatically by Jenkins by scanning who has made commits to the repository it is connected to.

To add a new user, clink on the Jenkins icon at the top left of the page, and go to the *Manage Jenkins* page - we've been here a few times now, so it should feel familiar to you. From there, select the *Manage Users* option. This will then allow you to click on *Create User* from the left hand pane:

Figure 1: Creating a New User

This will then let you fill in the new user form. The *Full name* and *E-mail address* entries are used when notifying users of problems with builds. Once a user has been created, they can log in and change their details, including their password, so it's fine to just create a random one to start with, as the user can reset it to something else later.



Create User

Username:

Password:

Confirm password:

Full name:

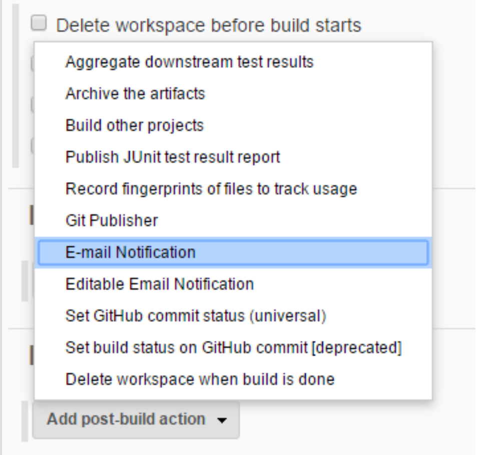
E-mail address:

To modify an existing user, click on the *Jenkins* icon at the top left, and then *People* icon from the left hand pane:

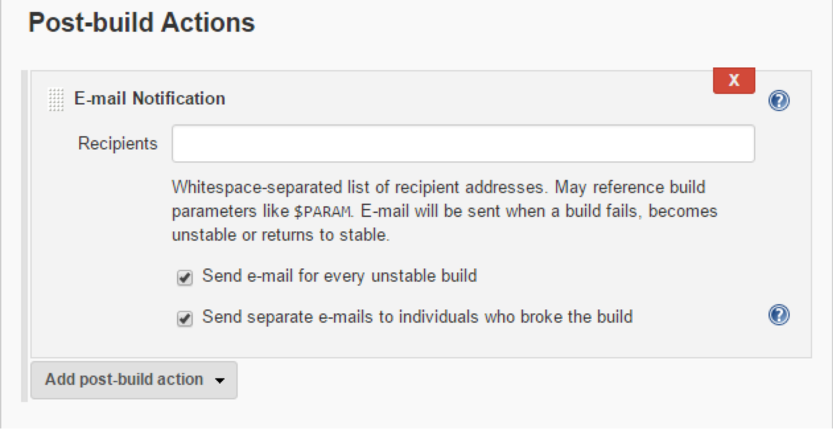
This will bring up a list of all users. If you click on a user on the list, you'll be able to see a *Configure* button on the left hand pane; clicking this will lead you to a page where you can set an email address to users that have been automatically generated from repository logs, or change passwords and add SSH public keys, often used as a security check in Git repositories.

Notifying Users

The final part of configuring Jenkins is to tell it what to email, when, and to who. To do this, we need to go back to the *Project Configuration* page we went to earlier when setting up source code management and build triggers. As before, click on the Jenkins icon in the top left of the screen, then click on your project, then click *Configure* from the left hand pane. This time, we're going to scroll down to the *Post-Build Actions* section of the page where you'll find the *Add post-build action* button - click it, then select *E-mail Notification* from the pop-up menu.


□ Delete workspace before build starts
Aggregate downstream test results
Archive the artifacts
Build other projects
Publish JUnit test result report
Record fingerprints of files to track usage
Git Publisher
E-mail Notification
Editable Email Notification
Set GitHub commit status (universal)
Set build status on GitHub commit [deprecated]
Delete workspace when build is done
Add post-build action

This will create a new item on the page, like so:



Post-build Actions

E-mail Notification

Recipients

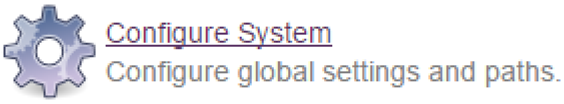
Whitespace-separated list of recipient addresses. May reference build parameters like $PARAM. E-mail will be sent when a build fails, becomes unstable or returns to stable.

☑ Send e-mail for every unstable build

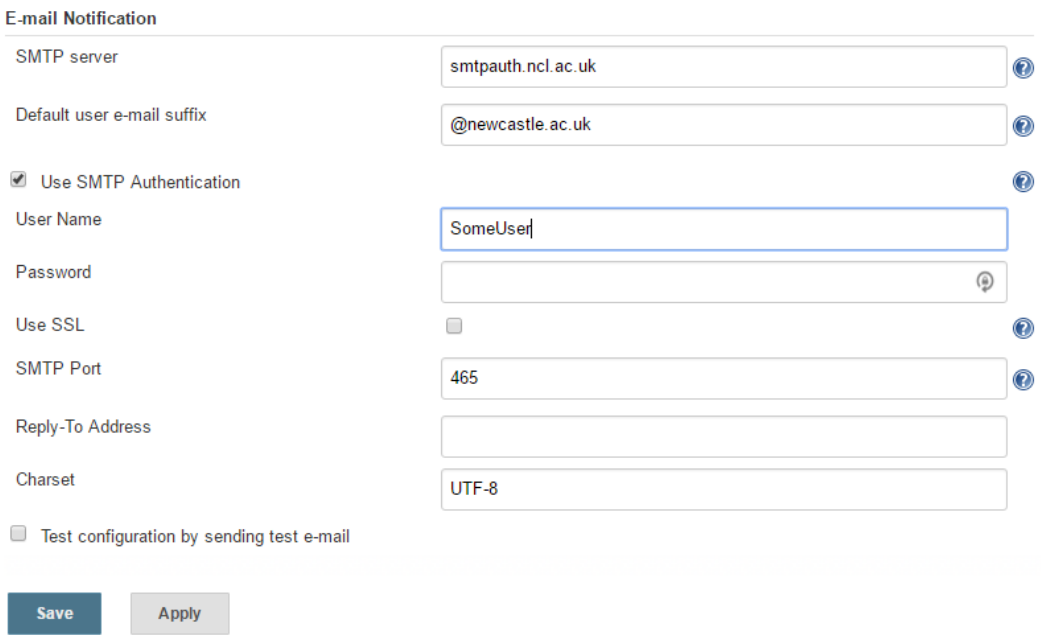
☑ Send separate e-mails to individuals who broke the build

From here, you can fill in a list of email addresses that should always be mailed when the project becomes unstable (or returns to stability) - it may be useful for a person to be designated 'in charge' of making sure builds get fixed, and so have their email address here. You can also check the Send separate e-mails box, which will inform users who have committed changes that prevent the project from compiling that they might have caused something bad to happen, and should take a look at the error logs.

There's one last step to making email notifications work correctly - Jenkins needs to know which email server and address to use when generating emails. To do this, we need to take one last trip to the main Jenkins Configuration panel, so click on the top left Jenkins icon, click *Manage Jenkins*, and then this time we're going to select the *Configure System* option:



Then, scroll down to the *E-mail Notification* section of the right-hand pane, and press *Advanced*. This will allow you to set up the server used for outgoing mail from Jenkins. If you are going to use the University's email server, you are going to have to set up SMTP authentication, so tick that box, and enter the details as shown:



E-mail Notification

SMTP server	smtpauth.ncl.ac.uk
Default user e-mail suffix	@newcastle.ac.uk
☑ Use SMTP Authentication	
User Name	SomeUser
Password	
Use SSL	□
SMTP Port	465
Reply-To Address	
Charset	UTF-8
□ Test configuration by sending test e-mail	

For the *User Name* and *Password* fields, someone in each team is going to have to provide their login details, to allow Jenkins to masquerade as them - everyone else on the team will just have to get used to receiving a lot of emails from this person! Once you've clicked *Save*, you'll finally be finished setting up Jenkins - it can now connect to a specific repository, retrieve the latest builds upon new commits, compile it as a Visual Studio project, and email people if the overall health of the project changes in some way.

Conclusions

Development of software as part of a team is a process fraught with difficulties - maintaining a solid working build can be difficult when multiple programmers are developing and using the same API, or concurrently writing code in the same file. At some point in every project, some conflict between code changes occurs, and the compilation of the project fails; this is natural, but it is important for the problem to be identified and corrected as quickly as possible. This is where continuous integration comes in, by allowing the process of compiling every possible combination of projects automatically as code is committed, and informing the coders of problems when they arise.

Jenkins is a very useful continuous integration tool, capable of integrating with the software packages you'll find yourself utilising over the course of your team project. This tutorial has shown you how to connect Jenkins up to a repository, determine when to try and grab the latest build off it, how to compile it, and how to tell the required people of any potential changes in the status of the project. It takes a little setting up to fully work, but it will save you time in the long run, as reacting to the messages Jenkins sends you will help prevent errors accumulating in your projects and leading to a tangled mess of code that must be laboriously fixed.

As powerful as Jenkins is, the most important part of a successful continuous integration methodology is you, the programmer. You must utilise the power that software versioning and continuous integration bring to a project, by helping it along the way as much as possible. Primarily, this is by committing code often to the project, rather than sending whole chunks of new code once per week. While you've been writing your week long chunk of code, other programmers have been making changes to the files you yourself are relying on, and you may find yourself working on out of date code. Furthermore, if you commit a huge chunk of code that results in the build breaking, it may be a difficult task to determine how best to fix the problem, due to being one part of a larger commit. It is far better to structure your commits in such a way as you make many smaller changes, so that the exact problem can be pinpointed quicker when it arises. It's also a good idea to update your project to the latest checkpoint on your repository before committing your changes, to catch obvious problems before they even make it into your next commit log!