The Beginner's Guide to Building a PC

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Introduction:

Building a PC can be a useful and rewarding undertaking for a number of reasons: First and foremost, you have complete discretion over what components you want and what amount you're willing to spend. You can craft a PC that suits your specific needs, allowing you to pay the least amount while getting a computer that's tailored to your preferences. The only alternative is to allow a computer shop to custom-build your PC, and this will result in markups ranging from $100 to upwards of $1000, depending on the build and the shop's pricing.

Secondly, assembling your own computer provides you with a deeper understanding of how the computer works and how the specific parts interact. It equips you with a knowledge base you wouldn't otherwise have. You'll be able to troubleshoot hardware issues more effectively, and you'll be able to upgrade components on your own as the need arises, saving even more money in the long run.

I created this book to help you do this. It covers every step of the PC building process from start to finish and will help you pick the right parts for your specific needs. Regardless of whether you're building your PC for gaming or office work, or just want to learn the basics of computer hardware, you'll find everything you need in the following pages.

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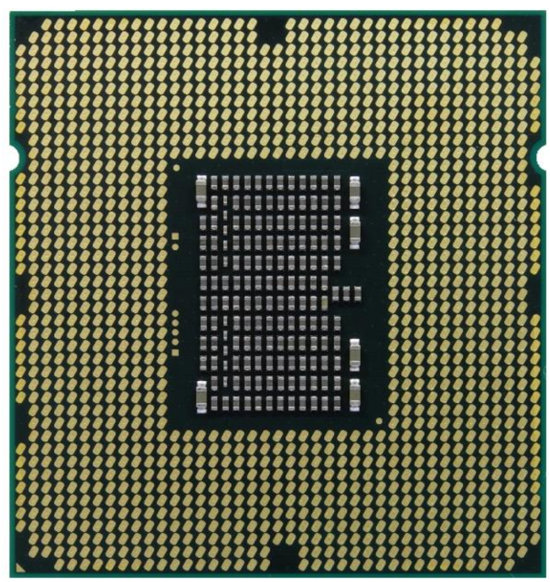
PART 1: PARTS OVERVIEW

Motherboard:

The Motherboard is the heart of the computer, so to speak. Everything connects to the motherboard in some way, shape, or form. When you plug in a mouse or an ethernet cable, you plug it into the motherboard. Graphics cards, RAM, the CPU, and storage drives all connect to the Motherboard. The most important factors to consider when choosing a motherboard are compatibility with other parts, most notably with your CPU. Below is a basic diagram, showing how the major parts interact with the motherboard (an Asus Prime Z370-A in this instance).

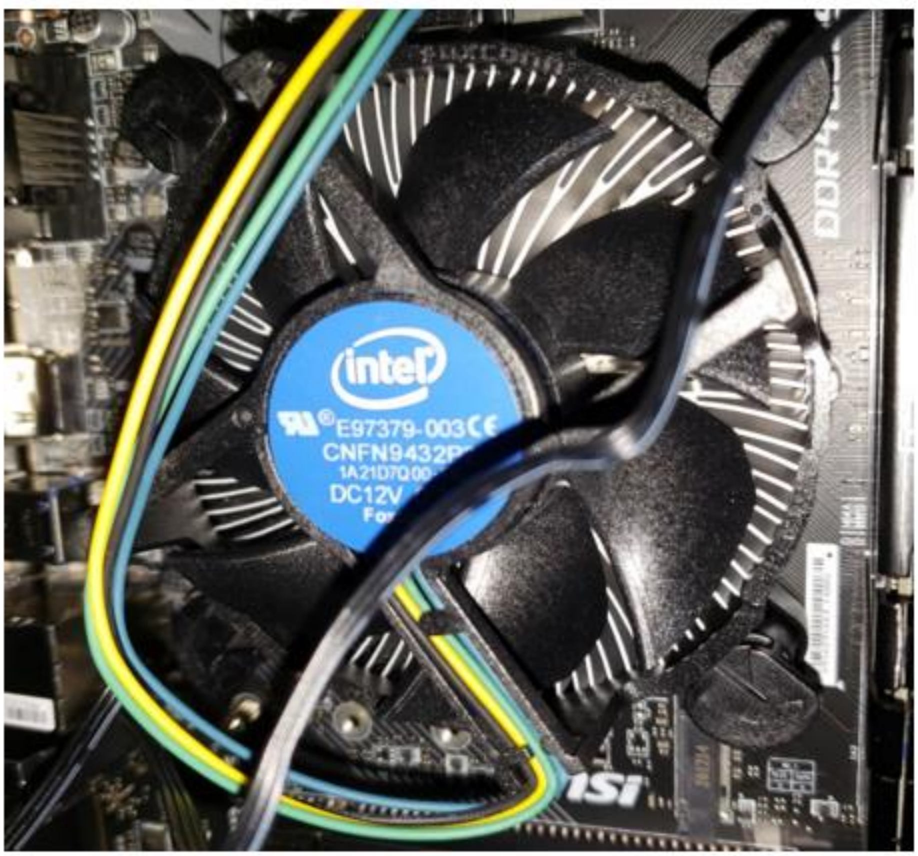
Central Processing Unit (CPU):

The CPU, also frequently called the processor, is one of the most important components of a computer. Without it your computer is useless. Almost all processes on a computer are performed by the CPU; it even generates the image on your screen if you don't have a graphics card (assuming your CPU has integrated graphics). It is monumentally important to pick a CPU that will be able to handle the workload you demand of it. Shown below is a graphic of the front and back of an Intel processor.



CPU Cooling System:

The cooler keeps your CPU's temperature in a safe range. Many processors come with a base-level cooling system which will suffice for many builds. If you have a high-powered processor with high clockspeeds, however, you may want to invest in a higher-quality CPU cooler. Thermal paste applied between the cooler and CPU helps the cooler remove heat from the CPU and keep it from overheating.



Shown above, an Intel stock cooler

Graphics Card:

The graphics card (also called the GPU or Graphics Processing Unit) generates the images you see on your screen. Typically, graphics cards are only needed by people building a PC with the intent to run games or graphical design software, although some people use lower-end graphics cards in conjunction with CPUs that don't have integrated graphics. A better graphics card usually translates to higher framerates when running games.

Shown above, a GTX Geforce 1080TI, a powerful Nvidia graphics card

Storage Drive:

The storage drive(s) in your computer are what determine its storage capacity. There are two main types of drive: HDD and SSD. Furthermore, the SSD category is broken into 2 types of its own: NVMe and SATA.

HDD: HDD stands for Hard Disk Drive, and has been around for longer than the SSD. As mentioned above, hard drives are more cost-efficient but not as fast at data retrieval.

SSD: SSD stands for Solid State Drive, the more recently-developed storage drive. SSD's retrieve information much faster, making them highly desirable. This means your system will also boot faster when using an SSD. The downside of this is that they cost a bit more per gigabyte of storage, so it isn't always feasible to have an SSD if you're on a budget.

- NVMe: NVMe stands for Non-Volatile Memory Express. This type of SSD is the fastest money can buy, more than 5 times faster than most SATA SSDs (more on those in a minute). This means that data is transferred to and from the drive much quicker than even a standard SSD, but as a result they cost more.

- SATA: SATA stands for Serial Advanced Technology Attachment, and refers to the motherboard port that SATA SSDs plug into. These SSDs are slower than their NVMe counterparts, but still much faster than traditional hard drives.

Shown above, a [Team GX2 1TB SATA SSD]

RAM:

RAM stand for Random Access Memory, and the amount of RAM you buy will determine how much temporary data you can store for near-instant access. It allows you to switch between different programs or tabs quickly. For example, if you had a lot of tabs open in Chrome, more RAM would allow you to switch between tabs without having to reload a page each time you switched back to it.

Shown above, 8GB of G.Skill Ripjaws RAM

Power Supply:

The power supply unit, sometimes abbreviated as PSU, is your computer's power source. It directs electricity from a wall outlet to your computer's motherboard, where it can be distributed to all of the components as needed.

Shown above, a Corsair 450W power supply

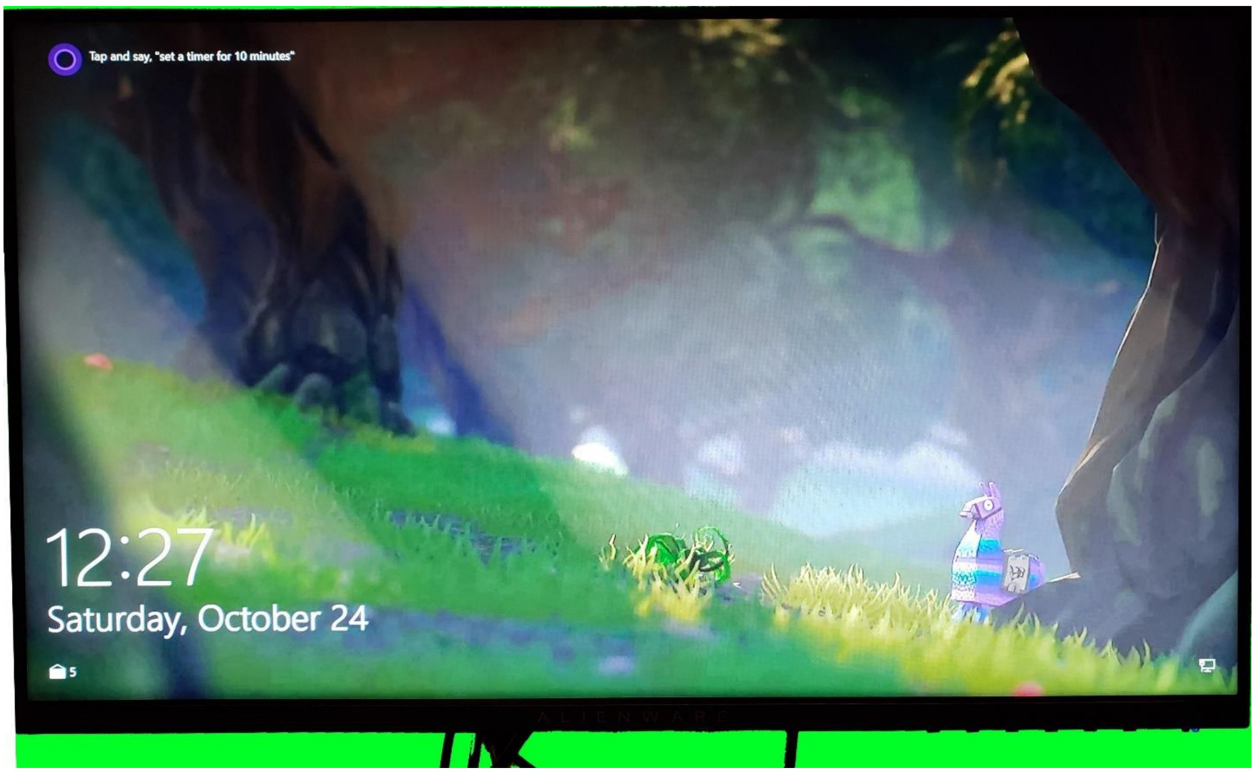
Case:

The case is the part of the computer you see. Sometimes called the tower, it comes in three main sizes: Full tower, Mid tower, and Mini tower. Unless you need to store your computer in a very small compartment, Mid or Full towers are the best option, since if you get anything smaller, you will probably need to get a significantly downsized motherboard. The case holds all of the components inside, and is the hub to which you connect almost all external cables (display cables like HDMI and DisplayPort, USB connectors, Ethernet cables, and more).

Shown to the right, a CoolerMaster MasterBox Q300L

Monitor:

The monitor is not technically part of the PC, but it is essential to the function of the computer. It is the screen that displays the images your computer generates.



Shown above, an [Alienware AW25HF]

PART 2: PICKING YOUR PARTS

Selecting the parts that will make up your PC is, perhaps, the most important part of the process. The hardware you select will determine how fast your PC runs, how quickly it is able to open up programs, what games (if any) it is capable of running, how much information can be stored, and much more. You will also need to check for compatibility. The best tool for this, in general, is www.pcpartpicker.com. This website allows you to create a custom build, and they have essentially every component available. It will only show you parts that are compatible with the other parts you have added. Below is a general guide on what to look for in each specific part.

Motherboard:

You don't need to spend big on the motherboard. The main factors to consider when choosing one are the number of RAM slots and compatibility with the rest of your components. In specific, CPU compatibility varies greatly between motherboards, since different generations and brands of processors feature different socket types. There's no need to worry about these specifics, though, because if you pick a CPU for your system build on PC Part Picker, it will then only show you motherboards that are compatible, thus simplifying the process a little.

Unless you're building a rig with dual graphics cards (which I wouldn't recommend) you won't need more than one PCIe slot. There are three main types of motherboard: ATX, Micro-ATX, and Mini-ITX. While there are many other sizes, they are not nearly as common as these three.

ATX: This is the full-sized motherboard, and comes with multiple PCIe slots and four RAM slots. It costs more and takes up more space than the other two sizes, but in exchange allows for greater customizability; you can have more RAM and run dual graphics cards if desired.

Micro-ATX: This is the mid-sized motherboard. It is generally cheaper than its smaller counterpart, and usually comes complete with four RAM slots and one PCIe slot. This should be enough for just about any PC build, since theoretically you could have 128GB of RAM and just about any graphics card.

Mini-ITX: This is the smallest motherboard, but it's typically more expensive than a Micro-ATX. It is usually only used when you need to fit your PC in a very tight compartment.

The best course of action is usually to decide what CPU, RAM, graphics card, and case to use first, then choose your Motherboard based on this.

CPU:

The CPU is probably the most important component, so it's important to consider thoroughly when picking one. There are two main brands to choose from: Intel and AMD. There are many generations of CPU's (Intel is on its 10th generation, and AMD's Ryzen processors are on their 5th) Within each brand, there are four main categories to choose from:

- The 9 category: Intel's Core i9 and AMD's Ryzen 9 processor. These are the most powerful processors available, and consequently the most expensive. You will only ever need an i9 or Ryzen 9 for pushing extremely high framerates or resolutions on the most demanding of games, or for extreme multitasking such as streaming and running games simultaneously.
- The 7 category: Intel's Core i7 and AMD's Ryzen 7 processor. These are extremely powerful processors and are capable of running games at very high framerates when paired with a good graphics card, and capable of running many programs at the same time with no trouble. The i7 or Ryzen 7 is typically the best processor choice for a gaming rig, as these can get 240 frames per second in all but the most CPU-intensive games. Their in-game performance is almost identical to

that of their i9 counterparts in most cases, so it's definitely worth saving the money if you can. They may also be the best option for you if you plan on having a very large number of programs running simultaneously.

- The 5 category: Intel's Core i5 and AMD's Ryzen 5 processor. These are still very strong processors and can pull at least 144 frames per second in most games when paired with a good graphics card. An i5 or Ryzen 5 is good if you're looking to build a gaming rig on a budget, or if you need to run office-type software (like word processors, Internet browsers, or spreadsheets) at maximum speed.
- The 3 category: Intel's Core i3 and AMD's Ryzen 3 processor. These are the cheapest processors, but also the least powerful. These are typically the best choice only if you're looking to build a PC for basic office-type functions as described above, such as email and Internet browsing. That's not to say they can't be used for gaming, though. Some higher-end i3 and Ryzen 3 processors can easily run AAA games at well upwards of 60FPS, so do your research before buying.

As such, it's worth noting that there is a great deal of overlap between these categories in terms of performance. This means that the best i3 is far better than the worst i5, the best i5 is a lot better than the worst i7, and the same goes for the i7 and i9. The Ryzen 5 5600x, for example, outperforms Intel's i9-9900k in gaming benchmarks. As a general rule, however, when comparing same-generation processors, the i9 is the best, followed by the i7, i5, and i3 in that order. The same applies to Ryzen processors.

Which is better: AMD or Intel?

It's impossible to say whether one of these two brands are superior. AMD and Intel both manufacture excellent processors, and in the current state of the market neither brand is the definitive best. In terms of gaming performance, Ryzen currently holds the top 4 spots according to the Tom's Hardware CPU Benchmark Hierarchy (which I'd definitely check out before settling on a processor), but Intel's high-end processors are still a force to be reckoned with.

Conclusion:

When choosing a CPU then, it's best to choose based on these general guidelines. Once you have narrowed your choice down to a category, you need to decide which specific processor you want (for example, there are 12 9^{th}-generation i7 processors). When building a gaming rig, decide what kind of performance you want from your PC and what resolution you intend to run it at, and run benchmarks. First, I'd start by looking at this list to get a good idea of how each CPU compares to its peers. Once you have a general idea of what price/quality range you're interested in buying from, I would test different CPU/Graphics card combinations here to get a reasonable estimate for what framerate you will be able to get, in what games, and on what settings. If you want to compare two different CPUs with the same graphics card, use this tool. If, say, you're looking to run Modern Warfare on low settings at 144FPS in 1080p, try different combinations of CPU and GPU to see how cheap you can get your build while still getting the quality you want. Consider the benchmark an overestimate and leave some margin for error, so if you want 144 frames, look for a CPU-GPU combination that gets around 180 in order to play it safe. Games can become less optimized over time (see Fortnite Battle Royale for a great example of this), so it's best to leave some wiggle room. If you're building an office-grade PC and don't intend to buy a graphics card, double-check that the processor you want has integrated graphics before you order it. Without integrated graphics, your processor can't create an image on the screen, *rendering* it worthless (I'm sorry).

CPU Cooling System:

Unless you plan to overclock your CPU (boost the speed it runs at to get better performance from it), the default cooler that comes with your processor should be more than adequate. For this reason, I won't cover the process of picking a CPU cooler in this guide, but if you decide you want to buy an aftermarket cooler here's a list of some excellent choices. It's also worth noting that some higher-end processors don't come with a cooler, so make sure to check before you order so you can get one if necessary.

Graphics Card:

The graphics card is another monumentally important part of your PC build. You won't need a graphics card for basic office utilities, but for things like gaming, 3D rendering, and high-resolution video editing it's essential to have a graphics card. The graphics card market, much like the CPU market, is dominated by 2 brands. AMD has its Radeon line of graphics cards, while Nvidia has its Geforce line.

Geforce cards can range in performance from can't-run-Valorant-at-30FPS office-grade GPU's to the RTX 3090, which is a beast of a graphics card to say the least (It's the indisputable best consumer-grade card available). Meanwhile, Radeon cards mostly fall into the lower-to-mid tier, but offer a better performance-to-cost ratio.

Choosing your GPU is fairly straightforward. Similar to the CPU-selection process, the best way to decide on your ideal graphics card is to look up benchmarks and figure out what card will meet your needs. Make sure to take your time and whittle your options down before making an ultimate decision. As I recommended when picking a processor, this is a great tool for comparing framerates with essentially any GPU-CPU combination. Tom's Hardware has also graced us with an excellent GPU hierarchy list, which you can view here, which should help you find where your prospective graphics card sits in relation to others.

Between these resources, it should be fairly simple to find your ideal graphics card. Find the general range in the hierarchy list that you think will give you the performance you need while not exceeding your budget, pick a specific card, and run a benchmark. If it performs better than is necessary (ie. It gets 300 frames per second in the game you will be playing when you're only planning on buying an 144hz monitor), you might want to try a less-expensive card in order to get more value while still getting the performance you're looking for. Picking a graphics card is a trial-and-error process, so it will probably take a decent amount of research before you finally find the exact one you're looking for. Keep in mind that your CPU heavily influences your computer's in-game performance as well, so it may be beneficial to try a different CPU in the mix as well.

A Note on Bottlenecking:

If you buy a CPU that is significantly more powerful than your GPU, or vice versa, this can result in a CPU or GPU bottleneck. What this means is that one piece of hardware is maxing out while the other is not using close to its full potential.

For example, a CPU bottleneck would occur if your processor was running at 100% of its capacity while your graphics card is only at 40%. At the most basic level, this means you inefficiently spent money. Your frames are capped by your CPU's performance, so even though your graphics card can handle the workload demanded of it easily, its extra power does you no good. You'd be better off buying a more powerful CPU and spending a little less on your graphics card, since this way you will get more frames per second at the same cost. Ideally both your processor and GPU will be at similar percentages when running games at full blast, as this indicates that your system is efficient.

It's also worth noting that some games are more CPU-reliant, sometimes referred to as being "CPU bound" or "CPU locked". The benchmark tool I showed earlier should account for this, but keep in mind that if you plan on playing multiple games, you should be aware of which ones are CPU bound so you can get a more powerful processor if you think that you will be playing these.

Storage Drive:

When deciding on a storage drive, the first consideration should, of course, be how much storage you need. If you know you'll be using your computer to create and store videos, download photos from your phone, install massive games, or house clips you'll need a decent bit of storage. I wouldn't recommend getting less than 1TB of storage most of the time, since storage is immensely cheap (Seagate has a 2TB hard drive for less than 40 bucks). The one exception to this is if you know you won't be storing any storage-heavy media on your computer (i.e. games, videos, and photos). In these instances, you probably don't need a terabyte and could likely get away with buying 500GB of storage, or even 250 in some instances.

After storage capacity, the real quandary is whether or not to buy an SSD. Solid state drives are a little bit pricier, but they are well worth the money. Your computer will boot much faster, and you can search for and transfer files much more quickly. Moreover, prices have dropped significantly in the past few years. Cost used to be a major factor when deciding between a solid state or hard drive, but now there are some 1TB SSDs available for under $100.

Should you decide to buy an SSD, you must now decide between a NVMe or a SATA model. In the end, it will come down to how much you are willing to spend. If speed is your top priority and you have money to spare, go with an NVMe. Otherwise, go with a SATA. These are still plenty fast for the average consumer.

To summarize, you need to make sure you get enough storage for your needs. That should be your first priority. The good news is that all modern motherboards support multiple storage drives, often up to four, so you can always buy another if you're running low on storage in a year or two. Secondly, if at all possible, you should purchase an SSD. It's worth every penny.

RAM:

RAM is another component that is typically worth spending a little bit extra on. If you're on a tight budget you can get by with 8GB of RAM, but you should never drop below that. There's only about a $20 difference in the cost of typical 8GB and 16GB RAM, and the smoother performance is well worth the slight uptick in cost.

It's also important to note the DDR type of your RAM. DDR4 is the most recent RAM type that is commonly available on the market, and is about twice as fast as its predecessor DDR3, so it's important to make sure that you're buying the best RAM.

If you will have many Chrome tabs, spreadsheets, text documents, videos, or anything of that nature open simultaneously, you may want to invest in a higher amount of RAM (32, 64, or even 128GB in extreme cases). If in doubt, know that most people never have occasion to use more than 32GB of RAM unless they frequently have a very large number of windows/tabs within a program open at the same time (think stock traders switching back and forth between spreadsheets and things of that nature).

Power Supply:

When choosing a power supply, your primary consideration should be its wattage. This is incredibly straightforward. The safest method is to use NewEgg's Power Supply calculator or a similar tool to see exactly how much power your system will drain. Multiply this number by 1.3 and then round up to the next multiple of 50. That's the power supply wattage you want.

If that didn't make sense, here's an example:

If NewEgg estimates my total system wattage will be 600W, I take:

600 x 1.3, which is 780. Now round up to the next 50W interval, which is 800. Based on this, I'll buy an 800W power supply. This is a good rule of thumb to use in order to account for any sudden spikes in energy usage that may occur.

The next most important aspect of a power supply is its modularity. Modularity means, essentially, the customizability of a power supply. Fully modular means that every single power cable can be removed, allowing you to only use cables that are needed. On the other end of the spectrum, non-modular power supplies have all of the cables built-in, and you are unable to remove them.

This means that, with non-modular cables, you will probably end up having excess cables that aren't connected to anything that are still taking up space in your case. The only benefit is that non-modular PSU's are cheaper. When choosing a power supply, I would recommend opting for a semi-modular design (a hybrid between non-modular and fully modular), as they are usually the most practical. The essential cables, such as the ATX cable that powers your motherboard and your CPU cable, are built in. Other cables like the 8-pin used for most graphics cards are modular, so you can use them if needed, but not have extra unused cables in your case.

PSU @ 115 V	10% Load	20% Load	50% Load	100% Load
80 Plus Standard	–	80%	80%/PFC 0.90	80%
80 Plus Bronze	–	82%	85%/PFC 0.90	82%
80 Plus Silver	–	85%	88%/PFC 0.90	85%
80 Plus Gold	–	87%	90%/PFC 0.90	87%
80 Plus Platinum	–	90%	92%/PFC 0.95	89%
80 Plus Titanium	90%	92%/PFC 0.95	94%	90%

Lastly you should give some thought to efficiency, which is usually listed as the “80-Plus” rating. When a PSU sends power to your computer, some percentage of the power from your outlet never reaches the computer, and is instead released as heat. The more heat is released, the less power reaches the computer and the less efficient the PSU is. This is where the rating system called the “80 Plus system” comes in. If 18% of the total wattage coming from the wall is lost in transit to your PC, your PSU is 82% efficient, and thus would earn a Bronze rating based on the chart shown above. If only 8% is lost, it would be 92% efficient, and would earn a Titanium rating. This is the premise of the 80 Plus rating system.

Which should I get?

In theory, then, you should always buy a Titanium-rated PSU, right? Not exactly. Take this EVGA fully-modular 650W PSU, for example. At the time of writing, it costs $155, nearly twice as much as the $80 price tag on its bronze counterpart shown here, for only a 9% jump in efficiency at full load. It would take nearly 10,000 hours, or over a year, of your computer running at full speed to save the $75 extra you spent on the Titanium (assuming a $.12/kwh electricity cost).

Which should you get, then? This entirely depends on your computer's intended use. If you're building a PC that you intend to use an absolutely monumental amount, such as for computations or very long-term crypto farming, then it may be worth it to buy a more efficient PSU. Otherwise, save your money and stick to the Bronze. For 99% of people, the difference in efficiency is negligible, while the price difference is not.

Case:

The case is one of the more fun parts to choose, since usually it boils down to aesthetics. If you need a case with a CD/DVD tray, SD card reader, or anything else specific make sure to ensure that the one you order has those features. Look for a case that comes with fans installed, as this will help keep your entire system cool. Ideally, you'll have at least one in both the front and back. Alternatively, you can buy extra system fans if your case is compatible.

If you know you're going to have to store your tower in a cabinet or tight space, it's good to check the dimensions and make sure your chosen case will fit. Likewise, if you already have your heart set on a certain motherboard, you will need to double-check that the case is compatible with that motherboard. Cases will have a set list of motherboard types they support so, for example, a smaller case probably won't support a full-sized ATX motherboard.

Aside from these considerations, picking a case boils down to what you want your PC to look like. Take your time, because you'll be looking at the case for as long as you have your computer.

Monitor:

Last but not least comes the monitor. You may already have one if you're upgrading from an old computer, but if not, you'll need to select a new one. The four main factors to consider with a monitor are size, response time, refresh rate, resolution, and adjustability.

Size boils down to personal preference and how much space you have. In my experience the ideal size for a monitor is between 24 and 32 inches.

Secondly, response time is important (mainly in conjunction with a gaming PC). Response time is the time it takes for a monitor to switch from one color to another. It sounds abstract, but in essence a lower response time means your monitor will be more responsive when playing games, and display the image in closer-to-real-time. It's difficult to notice any difference between a 10ms and 1ms response time, but you should aim to buy one that's 10ms or lower. Most good monitors these days are in the 1ms to 5ms range anyway, so it doesn't make sense to settle for less.

At this point you should have already decided on the rest of your components, and should have a good idea of what frame rate you'll be running games at. Your monitor should make full use of the frames your computer gets, so if your PC gets 144FPS on most games, you should buy an 144hz monitor. If it gets 240FPS, get a 240hz monitor. When on a budget, 144hz is usually the golden standard, since the jump from 60 to 144FPS is massive compared to the jump from 144 to 240. If you can't afford that, 60hz is still fine, especially if you're not playing games competitively, but shoot for 144hz if at all possible. They're very affordable; there are even some for less than $150 with a 1ms response time. If you won't be playing games on your PC, refresh rate still affects your overall experience, as it makes everything feel smoother, not just games, so it may still be worth the extra money on an 144hz monitor.

Next is resolution, which goes hand-in-hand with refresh rate. Your monitor's resolution will directly impact the framerate you're able to get, and the refresh rate you need. By this point, you should already have a specific resolution in mind, so buy a monitor that supports your desired resolution.

As a last consideration, look into your monitor's adjustability. Some come with an adjustable arm that allows you to move the screen up and down, which will allow you to view the screen at the desired height, rather than having to strain your neck. If this is important to you, make sure you get a monitor that includes this feature.

Conclusion:

As a final precaution, put all of your parts into PC Part Picker if you haven’t already. It doesn’t take much time, and it should catch any compatibility errors that may arise. Doing this will ensure that you don’t buy all of your parts just to find that they won’t work together.

PART 3: ASSEMBLING THE PC

This is the part you've been waiting for: assembling the parts and completing the masterpiece that is your PC. Keep in mind that it's impossible to write a perfect step-by-step guide to assembling a PC since there are too many variables at play, especially in case design. As such, some steps may vary slightly when building your own PC, but the bulk of the process should follow these steps. While I've attempted to write out the steps, many people find it easier to watch a video of their specific PC being assembled, as seeing it done helps a lot.

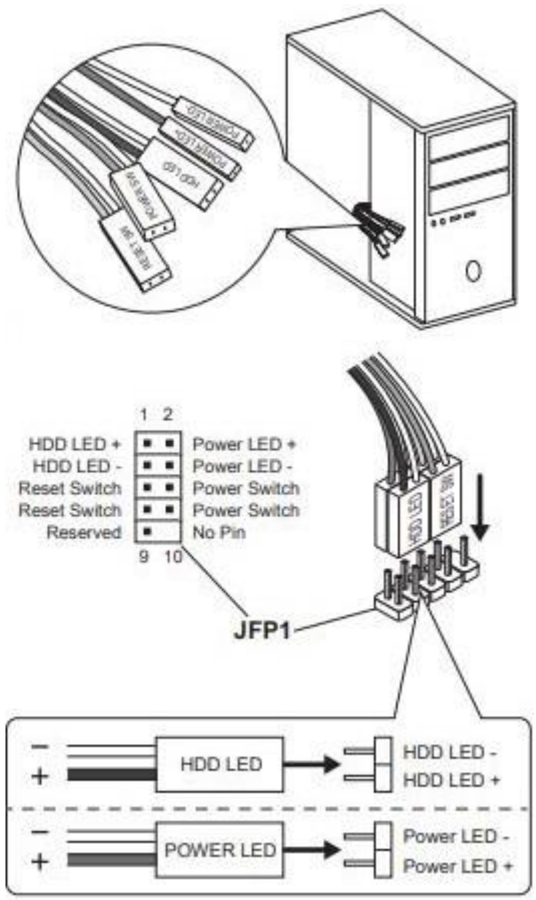
1. Take the side panel off of the case to access the interior. This should be held down by several large screws, which you can typically remove by hand.

2. Find the standoff screws. Usually these are found in a plastic bag inside of the case (shown below).

3. There are many small holes in the case, usually labeled with a letter next to them (usually “A” for ATX, “M” for Micro-ATX, or “I” for Micro-ITX). Screw the standoffs into the holes that match your motherboard type.
4. Find the IO plate, the shiny metal plate that comes in the package with the motherboard. Place it so that the text is readable and right-side-up when looking from outside of the case. Snap all four corners into place, making sure it is firmly secured.

5. Carefully remove the motherboard from its packaging. Set it on top of the box it came in.
6. Connect the case connectors to the Motherboard. These are usually coming out of the right side of the case, and include cables associated with audio, power, the reset switch, and LED's. You should always consult your motherboard's instructions at this point, since most motherboards are a little bit different from one another. Find the section in the motherboard's installation guide that looks like the one shown below. It will tell you which module to connect these cables to (JFP1 in the example below). From there, you need to find the module (it'll be labeled on the motherboard as well) and connect the pins in the exact layout shown on the manual. While it's entirely possible to

do this with just your fingers, it's a lot easier to use tweezers, as these cables are truly miniscule.



A MSI motherboard manual (above)

7. For Intel CPUs: Remove the plastic cover from the CPU slot on the motherboard. There is a small spring-loaded metal arm to the right of the CPU cover, which you'll need to pull to the right and then lift up. Once the CPU cover is up, you'll see the CPU socket. Remove the CPU from its package and line up the notches on the side with the notches

in the motherboard. Wiggle it a little bit if necessary, but don't push it in. It will settle into place without too much force. Once it is sitting down in the CPU socket, close the cover over the processor, and lock the metal arm into place the way it was to start with. If you have a Ryzen CPU, the process is slightly different, since the pins are in the CPU, not the motherboard. For more information, watch this video.

8. Take the CPU cooler from the packaging. Check on the underside to see if it has thermal paste on it. If there's a gray-silver liquid on the bottom-side of the cooler, you're good to go. If not, put a small dot of paste on the top of the CPU.

9. If the fan has a standard four-pin design (if it came with the processor, it should fall in this category) line up all four of the pins with the holes in the motherboard surrounding the CPU, so that the center of the cooler is directly on top of the CPU. Make sure the pins drop into the holes in the motherboard, then press the pins in from the top. Press the top right and bottom left down first until they click into place, then press the top left and bottom right. Verify that the cooler is secure by pressing on it gently. If you bought an aftermarket or AMD cooler, the

setup may be different. Consult the instruction manual for aftermarket, or [this link](#) for AMD coolers.

10. Take the 4-pin cable that's attached to the CPU cooler, and plug it into the nearby fan slot, usually labeled "CPU FAN."

11. Find the RAM slots and push down the tabs at the top and bottom (if applicable) of the slots you're going to use. If your motherboard has four RAM slots but you're only using two sticks, install them in the 2nd and 4th slot.

12. Now take the RAM sticks and line them up with the slot, making sure that the notch in the middle of the slot lines up with the notch in the middle of the RAM module. If not, it's probably backwards. Press one end of the RAM stick down until it snaps into place, then press the other end down until it does the same. Do this for all RAM sticks.

13. If your power supply is fully modular, you will need to find the 12-pin ATX power cable and plug it into the power supply. Do the same with the CPU cable. Now plug the other end of the cables into their respective slots. The ATX power cable usually plugs into a large slot on the right side of the motherboard, while the CPU cable's plugin is usually found towards the top-left of the motherboard near the processor. The usual plugin locations are shown below.

14. Find the SATA power cable that came with the power supply and plug it into one of the power supply's 6-pin slots. Now connect the other

end to your storage drive(s). If you have multiple storage drives, you can connect them to the same power cable, since it will have multiple plugins running along the cord.

15. Install the Power Supply. This step will vary based on your case, so you may need to consult the manual. Usually there is an opening at the bottom of the back of the case. Place the power supply inside the case, making sure that the fan faces downwards and the port for the power cord is on the exterior of the case. There will be screw holes in the power supply, and you can use the screws that came with the case to secure it.

16. Now find the SATA cable that came with the motherboard and connect it to the storage drive. Plug the other end into the motherboard in the slot labeled SATA, usually found on the right edge of the motherboard. If you have multiple storage drives, you'll need to run a SATA cable from each one to the motherboard.

17. Secure the storage drive(s) in the case. This will vary significantly from case to case. Drives are commonly stored in trays, screwed into the case, or attached to rubber gaskets that lock into the case. You will need to consult your case manual for this step. Make sure that your drive is secured in some manner to the case so that it's unable to move around and possibly dislodge one of its cables.
18. Now install the motherboard in the case. Slide it into place so that all of the ports on the left side of the motherboard stick through their respective slots in the IO plate, and all of the screw holes in the motherboard line up with the standoffs. It may take some force to position the motherboard correctly, since the IO plate has spring-like metal strips facing inwards.
19. Once the motherboard is in place, secure it using the screws that came with the case (these are usually found in the same bag as the standoffs). Tighten them a little at a time and make sure that the screws are snug but not overtightened, since this could crack the motherboard. You can tell the screws are tight enough when you are able to press gently on the motherboard without it rocking or wiggling.

20. Install the Graphics card. First, make sure to remove the protection cover over the PCIe slot, if present. In most instances there is a panel on the back of the case, directly to the left of the PCIe slots. Unscrew this panel, then unscrew the metal strip that's on the same vertical plane as the PCIe slot in which you intend to install your graphics card.

21. The PCIe slot will have a tab on one or both sides, much like the RAM slots did. Push down these tabs and line up the slit in the graphics card with the notch in the PCIe slot. Press the graphics card into the slot, first on the left side until your feel it snap into place, then on the right. If the tabs that you pressed down in the beginning pop back into place, this means that the graphics card is seated correctly.

22. Using screws that came with the case, secure the metal part of the graphics card outside of the case. If there was a metal plate that covered this, screw it back in as well.

23. If your graphics card requires an external power source, plug the 6-pin cable(s) into the power supply and connect them to the graphics card as needed.

24. Put the side panel back on and plug the cable that runs from the wall to the power supply in. Plug in your ethernet cable, HDMI or DisplayPort cables, and any peripherals that you want connected. You're finished with the build process, and ready to boot.

Part 4: Troubleshooting

I hope that when you press the power button for the first time your LED's light up, your case fans start spinning, and your computer boots up perfectly. Unfortunately, it doesn't always go that way. The good news is that the issue is frequently pretty simple, and can be solved with some simple troubleshooting. Here are some common things to try if your PC doesn't boot up on the first try.

1. Make sure your case cables are plugged in correctly. Consult your motherboard manual and make sure that you lined them up correctly. Since one of these cables controls your power button, if it's not in the right place your power button may not work, making it impossible to boot.
2. Make sure that your CPU cooler is plugged into the connector labeled "CPU FAN." If you plug it into another connector, your computer may erroneously think that a CPU cooler is not connected, and shut down to avoid overheating.
3. Disconnect all but one stick of RAM, and make sure that it is seated perfectly. If the computer boots when this is done, you either have a bad stick of RAM or one of the sticks weren't seated correctly the first time you put it in.

4. Disconnect the power from your storage drive. If your computer boots when this is done, it usually means that either the power cable or storage drive was faulty. Try with a different power cable if your power supply came with more than one.
5. If you have integrated graphics, take out the graphics card and try booting. If it boots without the graphics card, reinstall it and try again. Your graphics card may have been incorrectly seated the first time. If this doesn't work, you probably have a faulty graphics card or power cable running to your card.
6. Flash your BIOS. Your motherboard's BIOS may need to be updated to be compatible with newer processor models. Learn how to flash your BIOS here.
7. If all else fails, unscrew your motherboard and place it on a cardboard box. Try booting your system up outside of the case. If this works, check for anything that could have been touching the bottom of the motherboard. It's possible that you installed an extra standoff that didn't belong, and was touching the bottom of the motherboard causing a short.

8. If none of these options work and your PC still won't boot, it's worth ordering a new power supply and trying with that one. If this doesn't work, it's likely that your motherboard has been damaged. You can take your build into a shop if you're willing to spend the money, or order a new motherboard and start from scratch.

If you're reading this before you build a PC and are thinking twice about trying it after reading about everything that can go wrong, just remember that the majority of the time first-time PC builders are successful. Follow the instructions carefully and be gentle with the components, and you probably won't have to make use of this troubleshooting section.

PART 5: STARTUP

When you boot up your PC for the first time, you will need to have a boot device. The best way to do this is to buy a USB flash drive and download the Windows boot media using another computer. You can find the Windows boot media creation tool here.

After creating the boot media, insert it into a USB port on your newly-built PC and press a key. This will open the Windows 10 setup wizard, and it will guide you the rest of the way through the setup. It will prompt you to enter an activation key, but you don't have to have one. If you do decide to buy it, you can download it here.

If you don't buy Windows 10, the vast majority of your experience will be exactly the same as that of a paid user. The only difference is that you'll have limited access to security patches, updates, and a few other features, but these may not be worth the large price tag.

PART 6: PARTS LISTS

In this section I've put together several parts lists that have already been double-checked for compatibility. These builds each have a different purpose; one is a budget gaming PC, another a low-cost office PC, and so on. Keep in mind that the market is constantly changing, so use these only as suggestions and do your own research before buying.

Office Work PC:

This PC build won't be able to run most games, but it will excel at basic word processing, emailing, and watching videos on the web on a budget.

- Ryzen 3 3100
- ZOTAC GeForce GT 710
- Asus Prime A320M-K Motherboard
- G.Skill Ripjaws V Series 8GB RAM (1x8GB)
- TEAMGROUP GX2 1TB SSD (530MB/s)
- Rosewill FBM-06 Case
- Corsair CX 450W 80 Plus Bronze Semi-Modular Power Supply
- BenQ GW2480 24" 60hz Monitor
- HDMI Cable

60FPS Budget Gaming PC:

This gaming PC should be able to get 60 frames per second on low settings. If you're on a really tight budget, and want to run games at 60FPS, this may be your best bet. It's around $500 including the monitor.

- Radeon RX 550 4GB
- Ryzen 5 2600
- GIGABYTE GA-A320M Motherboard
- G.Skill Ripjaws V Series DDR4 (1x8GB)
- Western Digital Blue 2TB HDD
- Fractal Design Core 1100 Case
- Corsair CX 550W 80 Plus Bronze Semi-Modular
- BenQ 75hz 1ms Response Time 24" Monitor
- HDMI Cable

144FPS Budget Gaming PC:

This gaming PC should be able to get 144 frames per second on most games on low settings. It's a good mid-range PC, and costs around $700 with the monitor.

- Ryzen 5 3600
- Radeon RX 570
- Gigabyte B450M DS3H
- G.Skill Aegis 16GB DDR4 (2X8GB)
- PNY CS3030 1TB NVMe SSD (3500MB/s)
- EVGA BQ 500W Semi-Modular PSU
- CoolerMaster MB311L
- Asus VG248QG 24" 165hz 1080p
- For 144hz: DisplayPort Cable or HDMI 1.4 Cable

1650 | i3-10100 Build:

This was our Build of the Month for March 2021. It is very affordable, and can push 120 frames in almost any game. If you want to run games at higher settings or higher frames consistently and can afford the extra cost, consider upgrading the graphics card to a 1660 Ti or 1660 Super instead.

- Core i3-10100F
- MSI Ventus GTX 1650
- ASRock B560M-HDV
- G.Skill Ripjaws 8GB DDR4 (2x4GB)
- PNY CS3030 1TB NVMe SSD (3500MB/s)
- Fractal Design Focus G
- EVGA 550W B5
- Dell S2421HF 24″ 1ms 1080p
- For 144hz: DisplayPort Cable or HDMI 1.4 Cable

1660 Super | Ryzen 5 3600x Build:

This build should easily get 144FPS in most games on 1080p and 60FPS in 1440p.

- GIGABYTE GeForce GTX 1660 Super
- Ryzen 5 3600x
- ASRock B450M PRO4
- Corsair Vengeance LPX 16GB (2x8GB)
- PNY CS3030 250GB NVMe SSD (3500MB/s)
  Seagate BarraCuda 2TB (220MB/s)
- Corsair 275R Airflow: Black | White
- Corsair CX 550W 80 Plus Bronze Semi-Modular PSU
- For 1080P: Asus VG248QG 24″ 165hz 1080p
  For 1440P: Acer KG271U 27″ 75hz 1440p
- For 144hz: DisplayPort Cable or HDMI 1.4 Cable

1080p 240FPS High-end Gaming PC:

This PC will run most games on 240FPS on low settings, and many games at 240FPS on higher settings. While this build is a workhorse, it costs a significant amount, upwards of $1500.

- GIGABYTE Geforce RTX 2080 Ti
- Intel Core i7-9700K
- Hyper 212 EVO Cooler
- G.Skill Ripjaws V Series 32GB DDR4 (2x16GB)
- PNY CS3030 2TB NVMe SSD (3500MB/s)
- MSI Z390 A PRO
- Corsair Carbide SPEC-05 Case
- EVGA 750 BQ Semi-Modular PSU
- Alienware AW2518HF 240hz 1ms Response Time 25” Monitor
- DisplayPort Cable: you’ll need this for 240hz
- Thermal Paste: Not included with the Hyper 212 EVO

The Ultimate Gaming PC:

This build is the most powerful one available on the market. It should easily run any game at upwards of 360FPS, but its cost is proportional to its performance. Keep in mind that this build is largely for fun, as it would not be economical to build, and you could achieve 360FPS in most games with a cheaper build.

- Intel Core i9-10900K
- Corsair H100i RGB Liquid CPU Cooler
- Geforce RTX 3090 Graphics Card
- Asus ROG STRIX Z490-E Motherboard
- Corsair Vengeance RGB Pro 128GB DDR4 RAM
- PNY CS3140 2TB NVMe SSD with Heatsink (7500MB/s)
- Corsair iCUE 680X Smart Case RGB
- Corsair RM 750W Gold Fully Modular PSU
- Asus ROG 360hz 1ms Monitor
- DisplayPort Cable: you’ll need this for 360hz
- Thermal Paste: Not included with the Corsair H100i

Conclusion:

Thanks for reading! If you enjoyed this book, let me know. If not, please let me know what could be improved. If you want more information and guides like this, you can visit my website www.artofpc.com, where I post PC build guides, hardware and peripherals reviews, and more.